ENGINEERING NEWS

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ENGINEERING NEWS.

THE DETROIT RIVER CROSSING has been reported upon by the Board of Army Engineers appointed for that purpose. This board convened in Detroit, on May 1, 1889, and the report is accompanied by over 1,000 pages of testimony. The board deems a tunnel or a drawbridge out of the question, and believes that the high bridge proposed by Mr. LINDENTHAL would be least objectionable to navigators, and is the best plan. The report also approves of a Plan No. 2 for a low winter bridge. The high bridge first mentioned proposes a continuous girder of 1,000 ft. central clear opening and two side spans of 750 ft. clear opening, with a clear headway of 140 ft. above the river. The estimated cost was $8,000,000, and the tariff to be charged was 62 cts. per car for passage. The approaches would be about 1¼ miles long, and the grade 90 per cent. The low bridge with removable spans, referred to, proposes one clear opening of 1,000 ft.; one clear opening of 732 ft.; two clear openings of 200 ft. each, and two fixed spans (at the shores) of 150 ft. each. This plan requires five piers extending above the water, and three piers submerged to a depth of 30 ft. The board considers that the channel would thus be free from April 1 to Dec. 1, and the side spans of 200 ft. could be opened at other times for vessels desiring to pass. The board, in approving this as the least objectionable of the low-bridge plans presented, says that it is justly subject to greater objections on the part of navigators, and does not wish to be understood as endorsing the estimate of its cost submitted by the projectors.

THE NEW ORLEANS BRIDGE QUESTION has been reported upon officially since our last issue, and the Board of Army Engineers approves of the location and plans for a bridge above the city, as offered by Mr. E. L. CORTHELL, C. E. The report is decidedly against the location of a bridge below the city.

THE TORONTO ESPLANADE MOVEMENT, to lift the present surface tracks now running along the water front of the city upon an elevated viaduct, and at the same time construct a new union station, is gaining strength, and bids fair to result in a great improvement. Four reports on the question have been rendered, which were, in order of time, one by Mr. A. M. WELLINGTON, of New York, on behalf of the Board of Trade; one by Col. C. S. GZOWSKI, of Toronto, and WALTER SHANLY, of Montreal, on behalf of the city; one by Assistant City Engineer CUNNINGHAM and City Surveyor SANKEY, also on behalf of the city; and one by Messrs. J. GALT, J. H. ARMSTRONG and ALAN MACDOUGAL, of Toronto, on behalf of the Citizens' Association. The four reports agreed in the substance of their recommendations, and differed only in details, which, after various conferences between the engineers, have been practically harmonized in a joint report, agreeing in substance with the first report rendered. A joint esplanade committee, representing all the various bodies above, has been authorized by the City Council, and has the matter in charge. The understanding is that the city is to construct the works and grant running rights in perpetuity for an annual rental.

THE CHICAGO UNION TRANSFER RAILWAY CO. has been incorporated in Illinois to carry on a general freight transfer business between the various railways entering Chicago. The business of the company, which is to be conducted on the principle of the bank clearing house, will be managed by a Board of Directors chosen one from each company which shall become a member of the Association. It is proposed to consolidate the Chicago & Calumet Terminal Railway, now partially completed, with the new company, and to have the consolidated company become the property of all the railways and to be under their control. The business of the company will be carried on at the town of Lyons, where the general clearing houses and freight and transfer yards and warehouses will be built. The clearing house will be divided into twenty divisions, one for each company, aggregating over 1,000 miles of track, and giving storage room for 160,000 cars. The transfer yards are to be so arranged that each car can be moved independently of all the rest, and provision is made for the necessary round-houses and repair shops.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a head collision between two freight trains on the Northern Central Railway near Emigsville, Pa., in which three men were killed and two were injured. Two engines and about thirty cars were wrecked. The south-bound train is said to have been running in disobedience of orders.—A double-header freight train of thirty-three cars on the Denver & Rio Grande Railroad broke in three parts near Walsenburg, Col., on Dec. 17; the middle section of twenty-four cars overtook the first section, and an engine and fifteen cars were wrecked. Two men were killed.—A broken axle caused the derailment of the pay car of the Ohio, Indiana & Western Railway on Dec. 16. The Superintendent and Trainmaster of the road were killed.—A coal train on the New York, Susquehanna & Western Railroad went through an open draw at Little Ferry, N. J., on Dec. 14; the engine and twenty-three cars went down; three men were killed. The bridge-tender claims that the engineer did not obey the signal to stop, and it is said that the coal train was running very fast.—Two freight trains collided at the western end of the Victoria Bridge at Montreal, on Dec. 9, several cars being wrecked and the wreck burned.—The engine of a passenger train on the Milwaukee & Northern Railroad left the track on a bridge near Republic, Mich., Dec. 15, and with a baggage car, went off the bridge into the river,

BRIDGE ACCIDENTS are reported as follows: At Johnstown, Pa., the Lincoln St. bridge, Cambria bridge, and the bridge across the Conemaugh, at Woodvale, have been carried away by flood.—A trestle on the Louisville, New Albany & Chicago Railway near Frankfort, Ind., gave way under a fast train on Dec. 8. No one was injured. The east span of the Pennsylvania Railroad bridge over the White River, near Gosport, Ind., was carried away by a flood Dec. 10.—A wooden span of a highway bridge at Ansonia, Conn., gave way Dec. 13, under a wagon loaded with a 5-ton block of granite.—A bridge, or trestle, on the Chicago & Atlantic Railway, near Decatur, Ind., gave way under a freight train Dec. 14.—Several bridges in Central California have been washed away by floods.

HEAVY FLOODS have occurred in California, causing several washouts on the railways, carrying away a number of bridges, breaking levees, and doing much damage to property and agricultural country.

THE NEW YORK CENTRAL & HUDSON RIVER RAILROAD has issued an order directing all signal tenders to stand on the track for five minutes after each train has passed, with red light or flag, and after five minutes has elapsed to stand five minutes longer displaying a green signal. No train may run by the red signal, so that the chances of collision in the case of accident are materially lessened. A similar method of signaling is in use on some railways on the European continents.

THE LACK OF GUARD-RAILS ON THE BROOKLYN BRIDGE, at a point near the Brooklyn Station, referred to lately in this journal, has been remedied by placing there heavy pine guard-rails. The whole line is now laid with timber guard rails, placed on inner side of the track.

THE WESTINGHOUSE AIR BRAKE COMPANY, of Pittsburg, filed on Dec. 12 a bill in the United States court against the Boyden Brake Company, claiming that they have infringed on the Westinghouse patents for fluid-pressure automatic brake mechanism. An injunction is asked for.

THE LAKE ST. ELEVATED RAILWAY, in Chicago is under full headway. The contract is in the hands of Alberger & Fitzgerald, but Cofrode & Saylor, of Philadelphia, have the contract for the 4½ miles of metal work, and about one-half mile of the structure is already shipped from their works at Pottstown, Pa. This road is being erected on plans furnished by Mr. THEODORE COOPER, C. E.

THE FORTH BRIDGE WORK is rapidly drawing to a close, and the first indication thereof, outside of the structure itself, is the fact that an enormous store of machinery, plant, tools, timber, etc., is already offered for sale by the contractors for erection.

THE BALDWIN LOCOMOTIVE WORKS expect during the year 1890 to turn out not less than 1,600 locomotives. The output during October, 1888, was 104.

NICKEL STEEL is attracting the attention of metallurgists as the result of a paper read before the Iron and Steel Institute, in May last, by Mr. JAMES RILEY, of Glasgow. It is claimed that tests made with an alloy of 95.3 per cent. steel and 4.7 per cent. nickel showed an increase in breaking stress from 30 to 40.6 tons per sq. in., and the elastic limit was raised from 16 to 28 tons. The hardness can be increased 20 per cent. Steel rich in nickel is practically non-corrodible, 25 per cent. of nickel increasing this quality in the proportion of 10 to 870. Some of the breaking strains are said to have reached 87 and even 95½ tons per sq. in. The possibilities of this new alloy are rousing the nickel producers, and especially the Canadian Copper Co., which claims to have the best nickel mines outside of New Caledonia.

THE WESTINGHOUSE ELECTRIC COMPANY is introducing a newly patented system of electric lighting by arc lamps. The dynamo is constructed to deliver the required number of amperes whether the machine is supplying one lamp or its full load, and a short circuit cannot destroy the armature by overheating. The dynamo is automatic in regulation. The lamp is entirely new in design and superior in efficiency to the lamp in use; the carbon lasts for three nights, and the mechanism is very simple. It is so connected in the circuit that it will not transmit a shock to a person coming in contact with it, and lamps varying from 600 to 5,000 c. p. can be operated on the same circuit.

THE GULF STREAM, says Lieut. DOWNES, U. S. N., in a late article in the *Boston Transcript*, is flowing nearer to the New England shore than has probably ever been known before. This is in part at least owing to the weakness of the Arctic current, and its entire absence at times, in the North Atlantic. Lieut. DOWNES thinks this proximity of the warm Gulf Stream to our coast accounts for the comparatively mild, open winters of the past two years.

The Merchants' Bridge across the Mississippi River at St. Louis, Mo.

(8th Inset.)

The inset map and the accompanying cuts illustrate the general purpose and progress of the bridge now being fast completed by the merchants of St. Louis, as a new crossing of the Mississippi River at that point. The bridge is shown in general elevation on the next page.

As shown upon the map, this structure is located about 2½ miles above the old bridge, and ample connections are made on both sides of the river with all existing railroads. The bridge and its approaches are double-track. The river will be spanned by three trusses of about 520 ft. each, planned to give openings of not less than 500 ft. each in the clear, and a clear headway beneath in the centre of 52 ft. above high water. Approach spans on either side make the total length of the permanent steel and masonry bridge about 2,420 ft.

The river at this point is reduced to a width of about 1,600 ft. by a solid dike on the line of the east approach, and by a brush dike built at right angles to the river bank and parallel to the east approach dike, and about 1,000 ft. above it, and connected as shown on the plan, Fig. 2. It is the purpose of the United States Government and of the City of St. Louis to improve the harbor by bringing the river between the two bridges to a uniform width of 1,600 ft., so that the work done by the Merchants' Bridge Co. is in the direct line of this improvement.

Unlike the old bridge, the bed rock of the river is nearly level here throughout the whole length of the bridge; and the pier foundations were sunk by the pneumatic process to an average depth of 46 ft. below low-water. The pneumatic caissons for Piers I and IV, according to the specifications, were 26 ft. wide, 70 ft. long, and 17 ft. high each; and Piers II and III had caissons 28 x 70 x 17 ft. each. On the caissons of Piers I and IV, cribs 20 to 27 ft. high were placed, made of yellow-pine timber and planked outside with 3-in. oak plank placed vertically. The caissons had two thicknesses of this plank, with the inner layer spiked on at an angle of 45°.

The cutting-edge of the caissons was of iron, and an iron working shaft extended 20 ft. above the roof of the working chamber. This shaft, with a 24 in. supply shaft, a 4-in. air-pipe, a 5-in. water pipe, and two 4-in. discharge pipes, were all built into the timber work and masonry. The space above the working chamber and within the outer walls of the caisson and crib-work was filled with concrete. The first 2 ft. of this concrete above the roof was made of three parts sand to one part Portland cement, and into this sound stone was rammed after the mortar was in position; the top foot of concrete was made in the same manner. The rest of the concrete was made of Louisville cement, sand and stone, with two parts of sand to one of cement, and not over 60 per cent. of the whole volume in broken stone. All concrete was rammed, and the Portland cement and sand were mixed dry and then run through a mixing machine. The Louisville cement concrete was run directly through the machine.

When bed-rock was reached, it was levelled off or stepped and thoroughly cleaned of all loose shale, clay, etc., and at least two holes were drilled 5 ft. into the rock to determine its character. The caissons were filled with concrete, with the lower 2 ft. made of Portland cement, one part to three parts of sand; the remaining concrete was made of Louisville cement as above described. The masonry was first-class, rock-face work laid in regular courses. The stone was limestone, from Bedford, Ind., to a height of 3 ft. below low-water mark, and above that was granite; the dimension stone was laid in Portland cement mortar of two parts sand to one of cement, and the backing in American cement mortar, two to one.

At either end of the main bridge there is about 425 ft. of deck spans, and on the east side there is trestle-work which is eventually to be filled in with earth as shown on the plan. Over the Alton, Bee Line and Wabash railways there is one 175-ft double-track span and one 40-ft. girder span. On the west end of the bridge, beyond the 425 ft. of deck approach, there will be an iron viaduct over Ferry St., about 400 ft. long, then 600 ft. of wooden trestle, then a 126-ft. deck span with 40-ft. girders at each end, over Ferry St. again, and then a trestle, until the embankment is reached at a height of 25 ft. The grade on the west approach is 1½ per cent., while that on the east is lighter. The curvature on the west approach is 6°.

The law requires a clear height under the river spans of 50 ft. above high water. This has been increased to 52½ ft. in the center of the bridge in order to make a less abrupt change of grade in passing to the approaches.

The entire superstructure, excepting a few castings, is of steel. As the work now stands, the foundations, main piers, and the cylinder foundations of the approach spans are all completed. The west and middle spans of the main bridge are erected and the east span is being put up, as shown in Fig. 4. The foundations and masonry for street and railway crossings are nearly all completed, and the trestle-work and earthwork on both sides is well under way. It is reasonably expected that the bridge will be entirely completed before next summer.

Mr. S. W. COBB is President of the Bridge Company; Mr. C. C. RAINWATER is President of the Terminal Company; Mr. GEORGE S. MORISON, as Consulting Engineer, has charge of the design and manufacture of the superstructure; Mr. E. L. CORTHELL, as Chief Engineer, has charge of the construction of the bridge and its approaches; and Mr. H. W. PARKHURST, as Resident Engineer, has immediate charge of the work. Mr. ROBERT MOORE is the Chief Engineer of the Terminal Company and has charge of the terminals on both sides of the river. The Union Bridge Company of New York has the contract for the main bridge and the two 425-ft. approaches, and also the contract for the viaduct and bridge over Ferry St. and the bridges over the railways on the east and Angelica St. on the west approach. The firm of Anderson & Barr are sub-contractors for the foundations and the masonry of the main bridge. The terminal elevated structure along the levee is contracted to the Phœnix Bridge Company, of Philadelphia. The trestle and earth work is let to several parties. The work was commenced in February, 1889, and the contract calls for its completion by June 1, 1890, a date which, as before stated, will probably be anticipated.

Fig. 3. Merchants' Bridge; Main Piers.

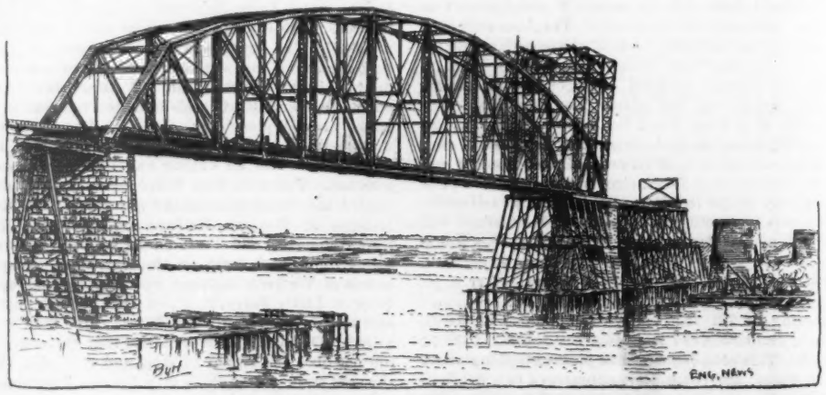


Fig. 4. Merchants' Bridge; Erection of Main Bridge.

As a specimen of one of the latest specifications for a first-class steel structure, as framed by an engineer of wide reputation, we give the part relating to the testing and manufacture of the steel members almost entire, as follows:

MATERIAL.—All parts, except nuts, swivels, clevises, wall pedestal plates and ornamental work will be of steel. The nuts, swivels and clevises may be of wrought-iron, the pedestal plates and ornamental work will be of cast iron.

All materials shall be subject to inspection at all times during their manufacture, and the engineer and his inspectors shall be allowed free access to any of the works in which any portion of the material is made. Timely notice shall be given to the engineer, so that inspectors may be on hand.

Steel may be made by the open hearth or by the Bessemer process, but no steel shall be made at works which have not been in successful operation for at least one year. Steel made by the Clapp-Griffiths process will not be accepted. All melts shall be made from uniform stock low in phosphorus, and the manufacturer shall furnish satisfactory evidence to the engineer that this class of material is being employed, it being understood that the finished product of open hearth steel is to be one in which the phosphorus does not average more than 8-100 of one per cent., and never exceeds 1-10 of one per cent., and in the finished product of Bessemer steel the average of phosphorus shall not be more than 4-100 of one per cent., and the maximum not more than 1-20 of one per cent.

A sample bar having one square inch cross-section shall be cut from the finished product of every melt. The laboratory test shall be made on this sample bar in its natural state without annealing.

The laboratory tests of steel made on the sample bar shall show an elastic limit of not less than 38,000 lbs. per square inch; an ultimate strength of not less than 63,000 lbs., nor more than 70,000 lbs; an elongation of at least 22 per cent. in a length of 8 in. and a reduction of at least 45 per cent. at the point of fracture; this elongation and reduction being the minimum and not the average requirements. In a bending test the sample bar shall bend 180 degrees and close back against itself without showing crack or flaw on the outside of the curve. Steel having

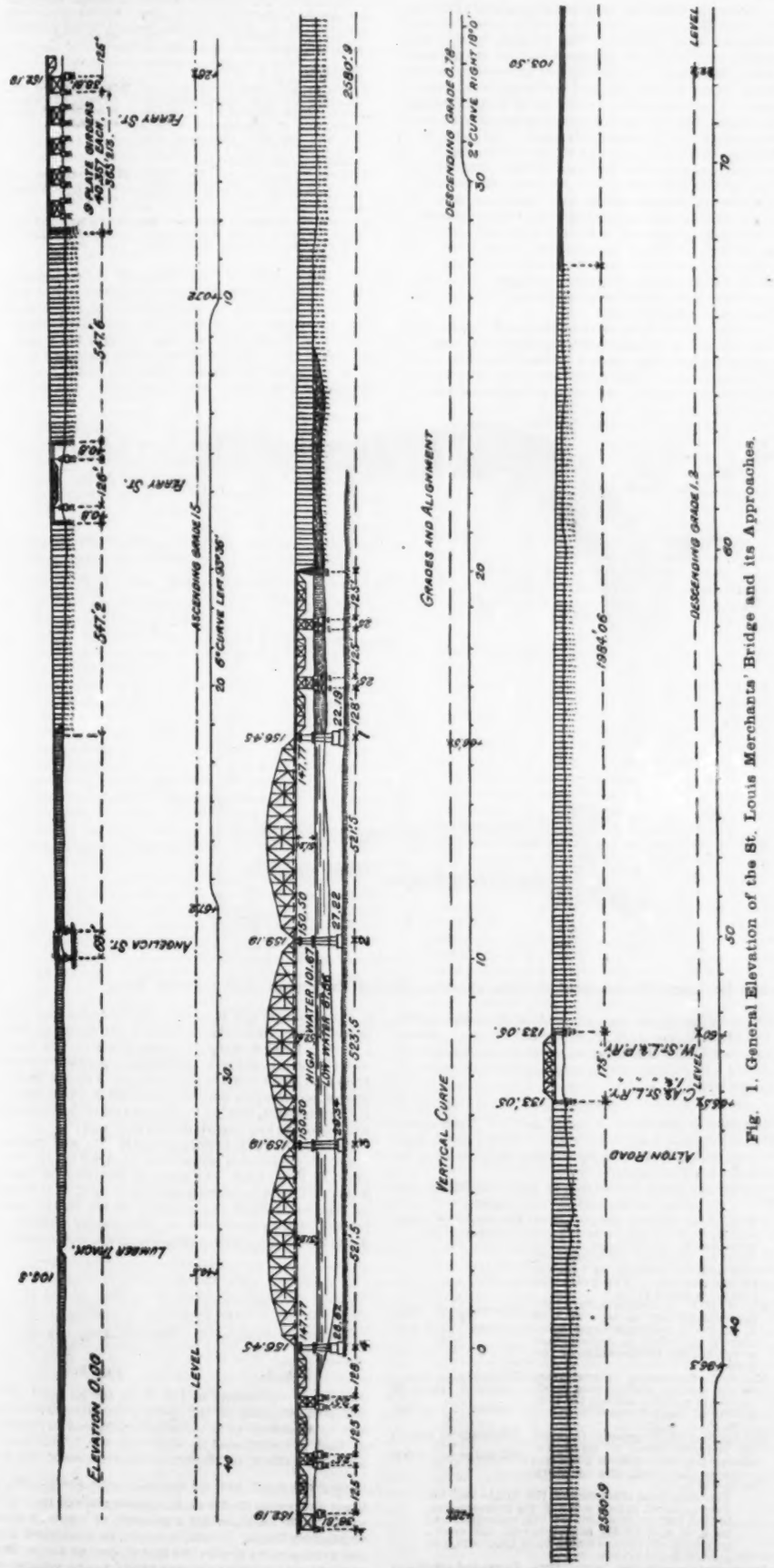


Fig. 1. General Elevation of the St. Louis Merchants' Bridge and its Approaches.

an ultimate strength of 60,000 lbs. per square inch will be accepted for rivets.

Should the contractor desire to use British steel, the quenching and bending tests specified in the Hawkesbury Bridge specifications will be required, and the elastic limit requirement may be waived.

Every piece of steel shall be stamped with a number identifying the melt, and a statement of the results of the laboratory tests of each melt shall be furnished by the contractor, certified by some person acceptable to the engineer, and accompanied by the tested specimens. Should the manufacturers make tests of bars rolled from sample ingots, certified copies of the report of said tests shall also be furnished to the engineer.

All sheared edges or punched holes in steel work shall be subsequently planed or drilled out, so that none of the rough surface is ever left upon the work. Steel for pins shall be sound and entirely free from piping, and pins more than 4 in. in diameter shall be drilled through the axis. Nuts, swivels and clevises shall be strong enough to break the members to which they are attached. Cast iron shall be of the best quality of tough gray iron.

Riveted Work.—All plates, angles and channels shall be carefully straightened before they are laid out; the rivet holes shall be carefully spaced in truly straight lines; the rivet heads shall be of hemispherical pattern, and the work shall be finished in a neat and workmanlike manner. Surfaces in contact shall be painted before they are put together. The dimensions given for rivets on the plans are the diameters of the rivets before driving.

Power riveters shall be direct acting machines, capable of exerting a yielding pressure, and holding on to the rivet when the upsetting is completed.

The several parts of each member shall be assembled, and the holes shall be drilled, the sharp edge of the drilled hole shall be trimmed so as to make a slight fillet under the rivet head, and the pieces shall be riveted together without taking apart. Should the contractor desire, the parts may be punched with a punch at least $\frac{1}{16}$ in. smaller than the diameter of the rivet as given on the plans, working in a die only $\frac{1}{16}$ in. larger than the punch; the several parts of the member shall then be assembled and the holes reamed so that at least $\frac{1}{16}$ in. of metal is taken out all around, the sharp edge of the reamed hole shall be trimmed and the pieces riveted together as above. All rivets shall be of steel; the rivet holes shall be of such size that the rivets shall fill the hole before driving, and whenever possible the rivets shall be driven by power. All bearing surfaces shall be truly faced. The chord pieces shall be fitted together in the shop, in lengths of at least five panels, and marked. When so fitted, there shall be no perceptible wind in the length laid out. The pin holes shall be bored truly, so as to be at exact distances, parallel with one another, and at right angles to the axis of the member. The pin holes in the vertical posts shall be truly parallel with one another, and at right angles to the axis of the posts. The posts shall be straight and free from wind.

The holes for the rivets connecting the floor beams with the posts and bolsters, and the stringers with the floor beams, and in general, the holes for all rivets which must be driven after erection, shall be accurately drilled to an iron templet. The holes for the rivets connecting the floor-beams with the posts shall be 1 in. in diameter, and the rivets of corresponding diameter.

Forged Work.—The heads of eye-bars shall be formed by upsetting and forging into shape by such process as may be accepted by the engineer. No welds will be allowed. After the working is completed, the bars shall be annealed by heating them to a uniform dark-red heat throughout their entire length, and allowing them to cool slowly. The form of the heads of steel eye-bars may be modified to suit the process in use at the contractor's works, but the form of the head adopted must be such as to meet the requirements of the tests of full-sized bars.

The heads and the enlarged ends for screws in laterals, suspenders and counters shall be formed by upsetting by a process acceptable to the engineer. The eyes on the 1 in. sq. counters may be bent around and weld-d.

Tests of Full-Sized Steel Bars.—Twenty full-sized eye-bars of sections and lengths used in the actual work, shall be selected by the inspector from the bars made for the bridge, for testing. Each of these full-size bars shall be strained till an elongation of 10 per cent. is obtained, and, if possible, broken. If broken, the fracture shall occur in the body of the bar, and shall show a uniform and ductile quality of material.

The contractor will be required to send the full-sized bars to Athens, Pa., to be broken in the testing machine at that place, unless some other machine has been specially approved for this purpose by the engineer.

The full-sized bars shall be selected from time to time as the work proceeds, the last bar not to be selected till all the eye-bars are manufactured. The tests shall be made from time to time as the bars are selected. When three bars have been tested, the bars manufactured up to the time of the selection of these three test bars shall be accepted or rejected on the results of such tests, and the same shall be done again when three more bars are tested. In these tests, the failure of one bar to develop a stretch of 8 per cent., or of the lot to develop an average of 10 per cent., before breaking, shall be sufficient reason for rejecting the lot from which these bars are taken. A failure to break in the body of the bar shall not be a sufficient ground for condemnation if it does not occur in more than one-third of the bars tested; but the above requirements as to elongation shall apply to the bars so breaking in the head, as well as to the others. The engineer shall, however, examine carefully into the cause of breakage of any bar which does not meet the

requirements, and if satisfied that the bar is not a fair sample of the lot, may order additional tests, and make the acceptance dependent on further results.

Machine Work.—The bearing surfaces in the top chord shall be truly faced. The ends of the stringers and of the floor beams shall be squared in a facer. All surfaces, so designated on the plans, shall be planed. All sheared and punched edges shall be planed or bored out.

All pins shall be accurately turned to a gauge and shall be full size throughout. Pin holes shall be bored to fit the pins, with a play not exceeding $\frac{1}{32}$ of an inch. These clauses apply to all lateral connections as well as those of the main trusses. Pins shall be supplied with pilot nuts, for use during erection, four for each size of pin. All screws shall have a truncated V thread, United States standard sizes.

The Popp System of Distribution of Power by Compressed Air in Paris.*

(Concluded from page 557.)

Fig. 3 shows graphically the relation between the quantities so far measured. If the area $A\,B\,C\,D\,E$ represents on any scale the work done in the steam cylinder, the area $A\,B\,C\,F$ represents on the same scale the work done on the air in the compressors. $C\,B$ is an adiabatic curve, $C\,G$ an hyperbola, so that $A\,G$ represents the volume of the compressed air when it has fallen in the mains to the temperature which it had initially at C. $G\,H$ being again an adiabatic curve, the area $A\,G\,H\,F$ (which is 61 per cent. of $A\,B\,C\,F$, and 52 per cent. of $A\,B\,C\,D\,E$) represents the maximum work which can be obtained from the air in a motor, the quantity calculated in the last paragraph.

If it be assumed that the temperature in the mains is constant, then any loss of pressure due to friction must

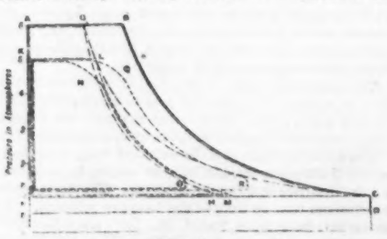


Fig. 3.

be accompanied by an exactly equivalent increase of volume. Thus if (Fig. 3) the pressure falls from A to K, the volume increases from $A\,G$ to $K\,L$, the point L lying on an isothermal through G. The loss of possible work due to such a reduction of pressure is presented by the difference between the areas $A\,G\,H\,F$ and $K\,L\,M\,F$, in both of which the expansion curves are adiabatic. The change of temperature in passing through a reducing valve is so small that it may be assumed without sensible error that the loss due to such a process may be calculated in the same fashion.

* A paper read by Prof. ALEX. B. W. KENNEDY before the British Association for the Advancement of Science.

I determined the loss of head in the mains by a series of observations made simultaneously at known points in Paris and at St. Fargeau. The pressure gauges used having been carefully compared, and all the necessary corrections made, I found the loss of pressure to vary from 0.35 to 0.25 atmosphere, according to the distance from St. Fargeau and the amount of air passing through the pipes. The average loss may be taken as 0.3 of an atmosphere at 3 miles from St. Fargeau, when the I. H. P. there was about 1,250, and the maximum velocity of the air in the mains about 1,550 ft. per minute. What proportion of this loss of head may have been due to leakage, and what the amount of leakage (if any) may have been, I had no means of determining. The duplicate main to which I have referred is not yet completed, and it was impossible to isolate any portion of the mains, even temporarily, to test for leakage. From the figures I have given, as well as from the nature of the pipe joint, I cannot doubt that leakage must, under any circumstances, have been extremely small.

In the table I have given approximate values of the loss due to fall of pressure in the mains and through the reducing valve, with various values of the total reduction of pressure. With a total reduction of half an atmosphere the combined efficiency of mains and valves is 0.96, reducing the maximum possible work at the motor to 0.5 I. H. P. per I. H. P. at central station. Under these conditions the minimum possible consumption of air per I. H. P. at the motor would be twice 348, or 696 cu. ft. per hour.

TABLE I.

Summary of Efficiencies of Compressed Air Transmission at Paris, 1889, between the Central Station at St. Fargeau, and a 10 H. P. Motor Working with Pressure reduced to 4½ Atmospheres.

(The figures below correspond to mean results of two experiments cold and two heated.)

1 I. H. P. at central station gives 0.845 I. H. P. in compressors, and corresponds to the compression of 348 cu. ft. of air per hour from atmospheric pressure to 6 atmospheres absolute. (The weight of this air is about 25 lbs.)	Efficiency of main engines 0.845.
0.845 I. H. P. in compressors delivers as much air as will do 0.52 I. H. P. in adiabatic expansion after it has fallen in temperature to the normal temperature of the mains.	Efficiency of compressors $\frac{0.52}{0.845} = 0.61$
The fall of pressure in mains between central station and Paris (say 5 kilometers) reduces the possibility of work from 0.52 to 0.51 I. H. P.	Efficiency of transmission through mains $\frac{0.51}{0.52} = 0.98$
The further fall of pressure through the reducing valve to 4½ atmospheres (5½ atmospheres absolute) reduces the possibility of work from 0.51 to 0.50.	Efficiency of reducing valve $\frac{0.50}{0.51} = 0.98$
The combined efficiency of the mains and reducing valve, between 5 and 4½ atmospheres, is thus $0.98 \times 0.98 = 0.96$. If the reduction had been to 4, 3, or 3½ atmospheres, the corresponding efficiencies would have been 0.93, 0.89, and 0.85 respectively.	
Incomplete expansion, wire-drawing, and other such causes reduce the actual I. H. P. of the motor from 0.50 to 0.39.	Indicated efficiency of motor $\frac{0.39}{0.50} = 0.78$
	Indicated efficiency of whole process with cold air, 0.3[illegible]
By heating the air before it enters the motor to about 330° Fahr., the actual I. H. P. at the motor is, however, increased to 0.54. The ratio of gain by heating the air is, therefore, $\frac{0.54}{0.39} = 1.38$.	Apparent indicated efficiency of whole process with heated air, 0.54.
In this process additional heat is supplied by the combustion of about 0.39 lb. coke per I. H. P. per hour, and if this be taken into account the real indicated efficiency of the whole process becomes 0.47 instead of 0.54.	Real indicated efficiency of whole process with heated air, 0.47.
Working with cold air the work spent in driving the motor itself reduces the available H. P. from 0.39 to 0.26.	Mechanical efficiency of motor, cold, 0.67.
Working with heated air the work spent in driving the motor itself reduces the available H. P. from 0.54 to 0.44	Mechanical efficiency of motor, hot, 0.81.

The motor on which I made most of my experiments was an ordinary horizontal Davey-Paxman engine with a single cylinder 8½ in. in diameter and 12-in. stroke, fitted with automatic cut-off gear. For convenience sake I tested it at St. Fargeau, and not in Paris; but I used a pressure only of 4½ atmospheres, which pressure I found to be exceeded on branch mains 3¾ miles from St. Fargeau, where I made later experiments. The position

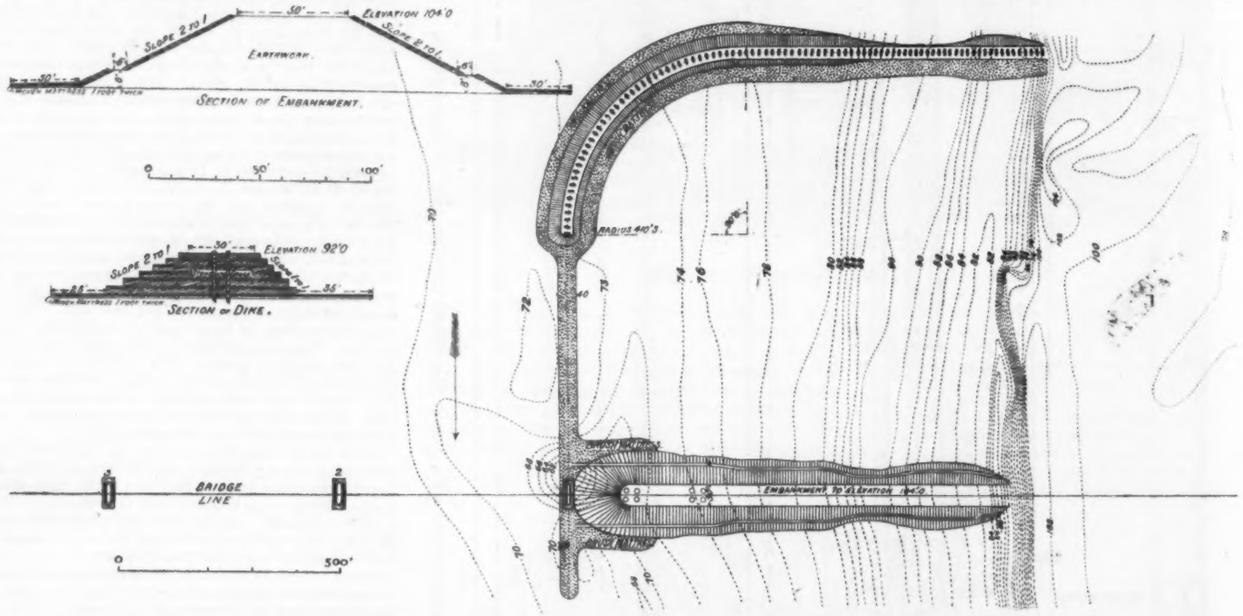


Fig. 2. East Approach to the St. Louis Merchants' Bridge, showing Diked Extension of the Shore Line.

of the motor did not, therefore, put it under any conditions different from those existing in the center of Paris. I made a large number of experiments on this motor under various conditions, individual experiments lasting from four hours down to half an hour. I shall here give figures representing only the four most important of my experiments, two with cold and two with heated air, averaging the two experiments in each case.

The motor, when indicating 9.9 H. P., and making about 125 revolutions per minute, used 800 cu. ft. of air per I. H. P. per hour. (Its indicator diagrams are shown in Fig. 4, their area being represented by $K\,N\,O$ in Fig. 2.) The work which this quantity of air, at the given pressure and temperature, is theoretically capable of doing behind the piston, expanding down to atmospheric

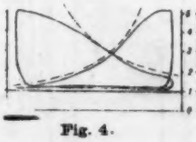


Fig. 4.

Fig. 5.

pressure, is equivalent to 1.27 H. P. for an hour. The indicated efficiency of the motor (the ratio expressing loss by rounding of corners, by insufficient expansion, by back pressure, etc.) is therefore 0.79. This figure gives us a check on the ratios already worked out, for if they are right the air actually used should be $\frac{1}{0.79}$ times as great as the 694 cu. ft. already allowed for. This would be 880 cu. ft., which represents, of course, a most satisfactory check. It will, however, be recognized that this arrangement checks the figures only so far as they apply to air actually used, and would not be vitiated or in any way affected by losses by leakage.

The vital measurements of all the experiments was, of course, that of the quantity of air used. The air was passed through one of the fan meters already described

readings of which were taken every quarter of an hour. After the experiments were over, air was passed through the same meter at exactly the same pressure, and in as nearly as possible the same quantity, and then passed, at atmospheric pressure, through two large standard wet gas meters. The readings of these were taken as correct, and the multiplier for the fan meter determined from them. I found from numerous experiments on several fan meters that this multiplier varied both with pressure and with quantity, but that the latter variation was very small within the limits of my experiments I have no doubt that the air quantities which I shall give you are correct within about 2 per cent. plus or minus.

It will be seen that the total indicated efficiency of transmission, with cold air, is 0.39 (see Table), in other words that work requires to be done at the rate of 2.6 I. H. P. at the central station per I. H. P. at the motor. The motor was worked on a brake, and its mechanical efficiency was found to be 0.67, so that (see Table) in round numbers 4 I. H. P. were required at St. Fargeau per brake H. P. at the motor.

To examine the economy due to heating the air before using it, I used the same motor, working as nearly as possible at the same power and speed, and with exactly the same pressure, but passing the air between the meter and the engine through such a heating stove as I have already described. I weighed all the coke used, and read the temperatures every five minutes during a four hours' trial. The air was heated in passing through the stove up to 315° Fahr., with a consumption of about 0.39 lb. coke per I. H. P. per hour. As the admission temperature on the cold trials was 83° Fahr.* only, this corresponds to an increase of about 42 per cent. in the volume of the air, and should therefore (had the indicated efficiency remained the same) have been accompanied by a decrease of air consumption in the ratio $\frac{1}{1.42}$ or 0.70. The air actually used was 665 cu. ft. per I. H. P. per hour, which is 0.75 of the 890 cu. ft. formerly required, so that the full economy is very nearly realized. The indicator diagrams are shown in Fig. 5, and are represented by *K P Q O* in Fig. 3. An air consumption of 665 cu. ft. per I. H. P. per hour corresponds to an indicated efficiency over the whole system of 0.52; in other words, 1.92 I. H. P. is required at St. Fargeau per I. H. P. at the motor. The mechanical efficiency of the motor was very much greater, hot than cold, rising to 0.81. Hence, about 2¾ I. H. P. at St. Fargeau gave one brake H. P. at the motor. These figures, however, take no account of the coke burnt in the heater, and are, therefore, only to be considered as *apparent* efficients. Allowing for the value of the coke in the manner already described, the real indicated efficiency of the whole transmission is 0.47.

A shorter experiment with slightly higher temperatures and considerably larger I. H. P. gave still more economical results, the air consumption falling to 623 cu. ft. per I. H. P. per hour, an "apparent" indicated efficiency of 0.56. This experiment was not, however, of sufficient duration to allow of coke measurement.

As to the value of the preliminary heating, the figures which I have given show that it caused a saving of 225 cu. ft. of air per I. H. P. per hour, at a cost to the consumer of about 0.4 lb. of coke per I. H. P. per hour. I do not doubt that the stoking of the heater during my experiment was much more careful than it would be in ordinary practice, although, on the other hand, it would not be difficult to design a more economical stove. If, however, the coke consumption were even doubled, it would only amount to 7¼ lbs. per day of nine hours for 10 I. H. P. the value of which might be 6d. or 7d. The air saved under the same circumstances would be over 20,000 cu. ft., the cost of which, at the high rate charged in Paris, would be 7s. 3d. ($1.77.) There is no doubt therefore that to attain the maximum of economy the preliminary heating of the air should be carried as far as is practicable.

Summarizing now the whole matter as regards efficiency, it may be said that the result of my detailed investigations is to show that the compressed air transmission system in Paris is now being carried on on a large commercial scale in such a fashion that a small motor four miles away from the central station can indicate in round numbers 10 H. P. for 20 I. H. P. at the station itself, allowing for the value of the coke used in heating the air, or for 25 I. H. P. if the air be not heated at all. Larger motors than the one I tested (and there are a number of such in Paris) may work somewhat more, and smaller motors somewhat less, economically. The small rotary motors would of course be much less economical. The figures which I have given are, however, such as can be reached by any motor of between 5 and 25 I. H. P. if worked at a fair power for its size. M. VICTOR POPP himself, and the engineers of the company, by no means content with the results already obtained, are experimenting in various directions with a view to greater economy, and I have not the least doubt that they will attain their end.

A system of transmission which has actually been carried out on a large commercial scale in such a way as to have an indicated efficiency of 50 per cent. between prime mover and secondary motor, four or five miles apart, is one which needs no adventitious aids to commend it to notice, especially where its convenience is so extremely great and its uses are so numerous and so varied as are those of compressed air.

While I am unwilling to lay stress on possibilities which are not yet actualities, there can be no harm in saying that I have no doubt whatever that, with more improvement of existing methods and appliances, and without the adoption of any new or untried methods whatever, the new plant of the Paris company now being constructed can be made to have an indicated efficiency of 67 per cent. instead of 50 per cent. and to give about 0.54 effective H. P. at the motor for each I. H. P. at the central station in the case of such a motor as that on which I experimented. Under these circumstances the air used per I. H. P. at the motor would be 520 cu. ft. or 650 cu. ft. per brake H. P. I have the less hesitation in giving these hypothetical figures because the more important imperfections of M. POPP'S transmission system arise from such a very obvious cause. Nothing, indeed, can be easier (as was evident on the recent visit of the Institution of Mechanical Engineers to St. Fargeau) than to point out various weak points in the arrangements adopted; and yet, in spite of all such somewhat cheap criticism, the fact remains that no one has yet carried out a compressed air transmission, with anything approaching the same success, on anything like the same scale.

I have already mentioned the great convenience and handiness which a compressed air motor possesses. From the engineer's point of view, these qualities are most striking. The engine starts, for instance, without the least hesitation even with full brake load on, directly the valve is opened, if the crank is just past the center. This, of course, is impossible with a gas engine, and hardly less impossible with any ordinary (single cylinder) steam engine. The absence of the heat and leakage, and of the noise and smell, which so often in greater or less degree accompany the smaller steam or gas motors, constitute a very much larger difference than could at first be thought possible. But from the consumer's point of view the advantages are even greater than from the engineer's. There is, first of all, the complete absence of danger and of nuisance of every kind. There is then the great saving of space even as compared with a gas engine, and much more as compared with a steam engine and boiler. There is reduction of insurance on account of the entire absence of fire risk. Not only this, but the air motor seems to me completely to supply that most important industrial want, a motor suitable for "small industries," that is, for work carried on in workmen's own houses, or in very small workshops. For here it is not only mechanically most suitable, but in the nature of things it can be made to cool or ventilate, by its exhaust, to any desired extent. The sanitary advantage of this in cases where work is carried on in confined spaces can hardly be exaggerated. Even in a very large printing office in Paris I found an almost unbearable atmosphere made quite pleasant as long as the motor was working, by allowing a portion of the exhaust to come into the room.

By using air direct from the mains in the motor, or by heating it only very slightly, the exhaust air can be, of course, so greatly reduced in temperature as to be available for freezing purposes. In one Paris restaurant, for instance, which I visited, I found that the exhaust was carried through a brick flue into the beer cellar. In this flue the carafes were set to freeze, and large moulds of block ice were also being made for table use, while the air was still cold enough in passing away through the beer cellar to render the use of ice for cooling quite unnecessary, even in the hottest weather. The nominal function of the engine in this case was the charging of batteries used in the electric lighting of the restaurant. The conjoint use of power and cold is common in Paris, the power being in this case generally applied in electric lighting, while in any large city such as Paris, it is no doubt a great point that by a compressed air system the handiest possible cooling appliances can be brought everywhere within reach; in tropical climates this is something rather of necessity than of luxury. In such cases we might have the apparent paradox of a motor worked essentially for its exhaust; the work done would be a bye-product, the cold air would be the principal thing. In such a case, if there were no useful work to be done, the motor could even be made (as has been suggested to me) to pump air back into the main, and thus virtually to about halve its air consumption. This possibility of "laying on" cold air in hot climates is, of course, a most important matter in connection with the future of compressed air.

Most of the compressed air in Paris is used for driving motors, but the work done by these is of the most varied kind. A list which I have gives the locality, use, and power of 225 installations, nearly all motors working at from ¼ H. P. to 50 H. P., all driven from St. Fargeau, and the great majority of them more than two miles away from it. In a number of cases (as at the Eden Theatre, Théatre des Variétés, office of the *Petit Journal*, etc.) the motor drives dynamo machines for electric lighting. In the offices of the *Figaro* and *Petit Journal* large motors are also used for printing.

One particular instance of variety of application which interested me much I may mention. At the "Montagnes Russes" I found a large horizontal engine, placed in a recess, driving a dynamo and cells for the electric lighting of the whole building; a small vertical engine in another place worked the rotary pump, which actuated the "cascade;" two or three large air-driven fans in wooden shafts served for ventilation; and, lastly, a simple connection on a flexible pipe threw the air-pressure into the beer barrels as they were brought in, and transferred their contents to a height from which they could afterwards descend by gravity to the place where they were required.

As to the rate at which the compressed air is sold, I believe that in most of the larger installations the work is done by contract (at so much per lamp-hour in the case of the electric lighting), but in the smaller ones the air is charged for by meter. The rate of charge is 1.5 centimes per cu. metre for air used in motors, and 2 centimes per cu. metre for air used directly. Air used for raising fluids is charged according to quantity raised. The former rate is equivalent to 4.25d. ($0.09) per 1,000 cu. ft. (the volume in all cases being measured at atmospheric pressure). In addition to this a fixed charge of from 100 to 250 fr. is made for pipes and connections, and a small rent for the motor if it be not bought outright or by twenty-four monthly instalments.

*This somewhat high admission temperature was the only point in which the motor at St. Fargeau differed from those in Paris, where I found the admission temperature to be from 60° to 70° Fahr.

The Sun's Eclipse of December 22.

Prof. DAVID P. TODD, of the United States Eclipse Expedition, gives in the *New York Herald* an interesting account of the preparations made to observe the eclipse of the sun for Dec. 22. The point selected by the party sent out from this country by Congress is not far from St. Paul de Loanda, on the west coast of Africa, a point of observation which lies in the middle line of the path of totality, and where the time of total eclipse will occur at about 3 P. M.

The purpose of these observations, says Prof. TODD, is not to find the distance to the sun, as many suppose, but to find out with the highest degree of accuracy the position of the moon's diameter relative to that of the sun at several recorded instants of observation. The data so obtained bear directly upon the betterment of the numerical data from which the astronomer predicts the position of the moon and is a matter of serious moment in the future of the science of navigation and in further improvement of astronomical tables and theories of the motion of the moon. But in addition to this purpose, the last twenty years have seen a great development of the science of solar physics, and observations of the solar corona, only seen at time of total eclipse, have much to do with this science. No one yet knows what this corona really is, and its study is depended upon to still further develop our present imperfect knowledge of the laws governing solar energy and the constitution of the sun itself. The importance of taking advantage of every solar eclipse can be appreciated when it is understood that in the last hundred years only a few hours over one day have been available for this purpose.

Photography is the most powerful adjunct of the eclipse observer of to-day. These plates preserve the precise figure and relative brightness of the corona and all its streamers with the highest precision, and permit careful and leisurely study to supplant the hasty and imperfect observations of only a few years ago. Spectroscopic investigation is also added to photography.

The outfit under the charge of Prof. TODD includes two powerful telescopes, with tubes made of steel plates, spirally welded and in two sections, each 20 ft. long. The telescope is supported at the upper fifth of its length by a braced strut hinged at both ends and running to a masonry support; at the lower fifth another collar and its hinge connects with another and larger masonry base, and between the two collars the telescope itself is trussed by five rods. The image of the sun, an image about 4½ ins. diameter, falls upon a large circular plate (22 ins. diameter) placed at the lower end of the tube. The axis of this plate is itself a small telescope parallel to the large one, and assures the exact pointing of the big instrument. When the object-glass is uncovered, a very narrow slit is made to travel rapidly across the opening at the lower end, and this momentarily exposes the big glass plate. As soon as the first exposure is over, a second automatic attachment operates and revolves the plate through 36° and at the same time sets the exposing slide for a

new operation. In this way ten photographs are taken upon a single plate with great rapidity, and these are developed at once. The motion of the sun during the two or three hours of eclipse is followed by means of a clockwork attachment.

The special feature of the center pivot is found in this arrangement of the two upper castings. The tendency of the table to tip laterally is prevented by the horizontal cylindrical surface, which is about 20 ins. in width. The table can, however, tip slightly longitudinally, so that when the locomotive runs upon it the trailing wheels bear upon the circular track; but whenever the center of gravity is within 16 ins. of the middle of the table, a full bearing surface is furnished, and the tendency of the trailing wheels at both ends is to rise clear of the circular track, and to remain so while the table is being turned.

rounded corners, and is provided with four bolt holes 2 ft. 2 ins. apart, center to center in each direction. These four holes are intended to receive four wedge bolts 1⅛ in. in diameter, let into the center bearing stone. The bolts should have 2-in. projection above the stone to the under side of the nut. The center bearing stone should not be less than 3 ft. square. All the parts of the center pivot are made to exact gauge, so that they can be duplicated at any time; they are the same size for all tables.

The vertical adjustment of the table is provided in a very simple manner; there are no screw bolts for adjusting the height at the center; this can be most readily accomplished by a wrought-iron plate between the pivot and the masonry, should it at any time be required. The adjustment at the ends of the table is provided by simply changing the number of thicknesses of the packing plates which are inserted between the journal boxes of the trailing wheels and the channel iron cross-girders which carry these, whereby the height of either of the trailing wheels above the circular track can be fixed as desired. All tables are provided with four packing plates, ⅜-in. thick, for each journal box. Two cast-iron sockets for wooden levers, and two latches are furnished for each table.

This standard turntable is proportioned for turn-

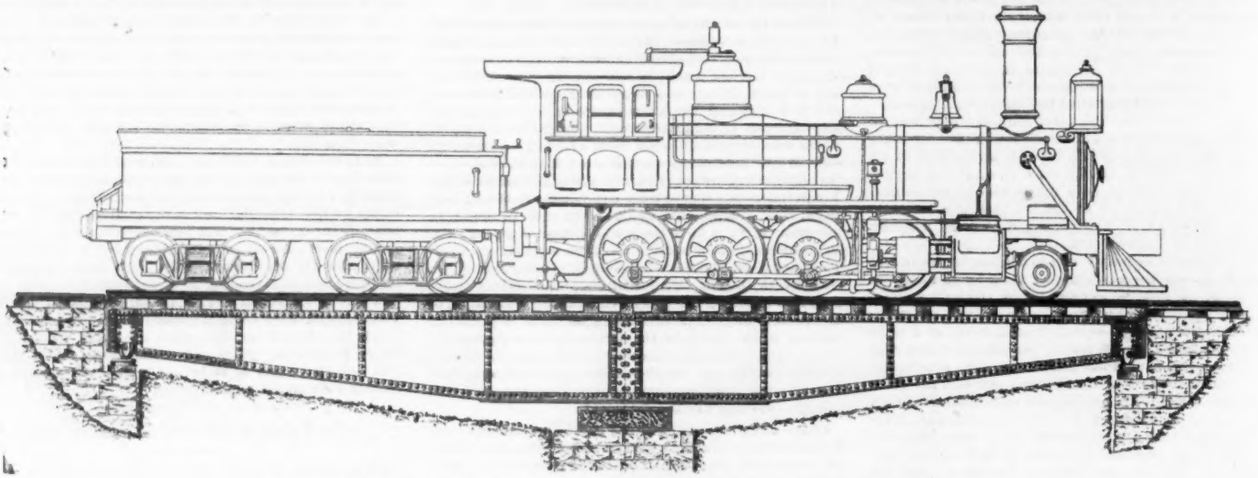


Fig. 1. Wrought-Iron Deck Turntable. Cofrode & Saylor, Philadelphia, Pa.

Among the instruments lent by the Harvard College Observatory are a quartz and two flint spectroscopes, and a reversing layer spectroscope; a large polar axis; an astronomical clock; a large duplex telescope for photographic study of the photometry of the sun's corona; duplex cameras and reflecting telescopes for photographing the polarization of the light of the sun's corona; a pneumatic apparatus for operating about 48 "shutters," etc., in photographing, etc. etc. All of these instruments will be solidly mounted on brick and iron braces, within a Ducker portable house, such as has before been described in this journal. The apparatus includes many delicate and ingenious automatic attachments for use in photography; the extreme value of every fraction of time saved being measured by the fact that the period of total eclipse will last little over three minutes of time.

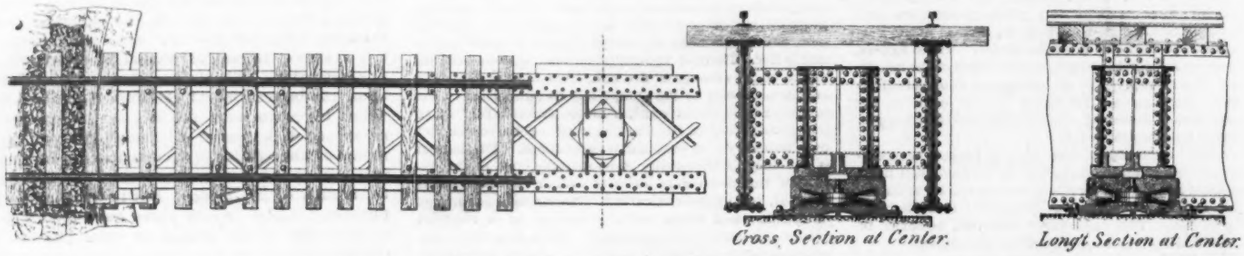


Fig. 2. Plan and Section of Wrought-Iron Deck Turntable.

Wrought-Iron Deck Turntable.

The accompanying cuts illustrate a type of wrought-iron deck turntable for locomotives, as manufactured by Cofrode & Saylor, of the Philadelphia Bridge Works, and patented in 1887 and 1889 by Mr. F. H. SAYLOR, C. E., of the firm named.

In this turntable the main carrying girders are solid-web riveted girders with angle-iron lateral and diagonal bracing. The cross-girders are also made of plates and angles firmly riveted to the main girders, as shown in Figs. 1 and 2. The construction of the center pivot can best be understood by an inspection of the sections shown in Fig. 2. The upper casting of this pivot has a square projection on top, planed so as to fit inside the box formed by the cross-girders, to which latter it is firmly bolted. The middle casting forms the top of the roller-box, and its top is planed to a flat cylindrical surface, having its axis at right angles to the table and accurately fitting the lower surface of the top casting. A wrought-iron key is inserted between these plates to prevent the two surfaces from sliding upon each other.

Steel plates, made to fit exactly the planed conical surfaces of the lower and middle castings constituting the roller box, provide bearings for the conical rollers.

A. Diameter of pit	35′—0″	40′—0″	45′—0″	50′—0″	55′—0″	60′—0″
B. Diameter of track circle, c. to c. of rails	33′—2″	38′—2″	43′—2″	48′—2″	53′—2″	58′—2″
C. Length of girder, out to out	34′—4″	39′—4″	44′—4″	49′—4″	54′—4″	59′—4″
D. Distance from base of rail on table to top of center stone	4′—2″	4′—4½″	4′—7″	4′—9½″	5′—0″	5′—2½″
E. Distance from base of rail on table to top of circular track	2′—11½″	2′—11½″	2′—11½″	2′—11½″	2′—11½″	2′—11½″
F. Distance from fixed base of rail table to top of circular track	2′—11″	2′—11″	2′—11″	2′—11″	2′—11″	2′—11″

Between these steel plates are chilled iron conical rollers, ground to exact size, each 6¼ ins. in length, almost completely filling the roller box. In addition to these conical rollers there are two hardened steel bearing plates, the lower being doweled to the base casting and the upper provided with oil grooves to insure free turning. The roller box is oiled through a wrought-iron pipe extending through a plate iron cover on top of the cross frame.

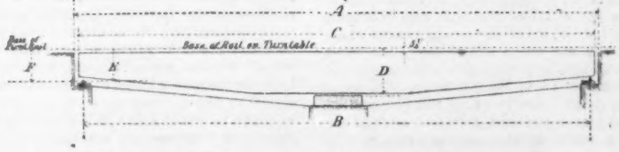


Fig. 3. Dimensions of Pit for Deck Turntable.

The lower half of the roller box constitutes the base plate, and is 2 ft. 8 ins. square, with slightly

ing an 86-ton consolidation locomotive, or an equivalent load; and they are turned out in lengths varying from 35 ft. to 75 ft. In a following issue we will show a half-through wrought iron turntable as made by the same firm.

A useful table of dimensions of pits, for turntables adapted to lengths varying between 35 ft. and 60 ft., is issued by the firm named, and is given herewith.

Prophecy in Caricature.

An old print, here reproduced, comes to us without other title than that given and with no clue as to its date of issue, but it is a genuine old print and is worthy of some study and comment. The date of this caricature is probably 1825-27, a period antedating the famous trial of locomotives running on metal rails, and marking a time when the coach was still the accepted type of vehicle and the general public still looked upon their highways as the roads of the future; the only change anticipated was that steam would "somehow" supplant horses.

Invented by Horatio Heartly. Designed by R. Transit.

THE STAGE COACH,

In our issue of Sept. 8, 1888, a caricature of a "steam-buggy" was shown, issued probably at about the same period as the above. But this particular cut is chiefly interesting from the fact that the artist, in attempting to reach the supreme height of absurdity, builded better than he knew. This was supposed to be a London and Brighton coach. The distance between the two places is fifty-two miles. The inscription on one of the panels promises the phenomenal—and presumedly impossible—speed of "To Brighton in 2 hours." The locomotive hauls the modern steam coach from London to Brighton in about one hour

Studying the outfit further, we find that the prophetic soul of R. TRANSIT has really inspired him to depict the prototype of our latest "vestibule railway train" in the conveniences to be put at the command of the traveling public. The soldier on the upper seat may be said to be occupying the smoking compartment; and the stout gentlemen in the "boot" are evidently enjoying the practical advantages of a modern buffet or dining-car. The cook is not so securely housed as he is to-day, but if the inscription on the boot be not false, he is prepared to compete with his Pullman brother in the character of the good things served up. And while no especial conveniences for this purpose are shown, another panel promises "shampooing, bath," in other words, the latest barber-shop adjunct to the vestibuled train of to day.

The artist's name, fully set out, is probably RAPID TRANSIT, and he doubtless believed that in his picture he had added about all the "impossible" features of fast traveling that a vivid imagination could suggest. The design is but one example among many of the inadequate appreciation of the people of the first quarter of this century of the revolution that was to follow the introduction of steam as a substitute for the old-time coach-horse.

Railroad Signals and Signaling.

At the present time two of the most important subjects which are engaging the attention of railway men are the use of interlocking apparatus at important terminals and junction points, and the introduction of the block system to take the place of the train order system of train operation, whose inherent dangers, despite all vigilance and care, are generally acknowledged.

At the last meeting of the New England Railroad Club, Mr. R. H. SOULE, of the Union Switch & Signal Co., read the following carefully prepared paper upon "Railroad Signals and Signaling."

While the planning of complicated systems of interlocking requires the thorough study of a competent signal engineer, it is well for every railroad manager and superintendent to understand what has been effected in the promotion of safety by the ingenuity of signal engineers and designers; and Mr. SOULE'S paper gives these important facts in an admirable manner.

HISTORY OF INTERLOCKING APPARATUS.

The subject of signalling and interlocking began to receive earnest attention in this country in the year. 1875 and 1876. The principles of block signalling had been understood and applied for some years previous; but the first interlocking apparatus (the Saxby & Farmer apparatus at East Newark, on the Pennsylvania Railroad) was not installed until 1874. This was followed by the introduction of a number of Toucey & Buchanan machines on the New York Central in 1875, and on the Pennsylvania in 1876. The Saxby & Farmer machine at East Newark was imported from England, and was set up by English mechanics from the home shop. The Toucey & Buchanan machines were built by the railroad companies who put them in.

The English had many years experience in signalling and interlocking prior to the time when the subject was taken up in this country. They had begun to assemble levers together as early as 1846; this was followed by crude interlocking devices, until the Saxby patents of 1856 and 1860.

We inherited from English practice two important facts which have had a great influence on the development of signalling and interlocking in this country,—the survival of the semaphore as the best type of signal for railway purposes; and the principle of preliminary locking, which is now universally accepted as a correct feature of sound interlocking.

It should be noted that the Toucey & Buchanan machine was defective in that it did not embody this feature of preliminary locking. The result was that in a very few years all the original Toucey & Buchanan machines were replaced with Saxby & Farmer machines Since 1876 the manufacture and installation of signalling and interlocking plants in this country has become a specialty, principally in the hands of private concerns. During this period the introduction of signalling on our American railways has been steadily increasing; but our territory is so enormous, our construction of new lines so rapid, and our unprotected localities so numerous, that there is sure to be an extensive field for good work of this character for many years to come.

FORM OF SIGNALS.

The semaphore has been referred to as the best form of visible signal. This is certainly true for all signals that are approached at high speed, and must be seen from a distance. Custom has prescribed that home signals should be painted red and distant signals green, although at least one large system in the West has adopted yellow as the standard color for all semaphores; the claim being that the semaphore is merely a position signal, and that therefore it may be of that color which will be most effective, and which will make it visible from the greatest distance under adverse conditions.

It may be confidently stated that when other forms than the semaphores are used as high-speed signals, the reason lies either in the desire to use a cheaper signal, or in the fact that the motive power used to work the signal is not sufficient to overcome the inertia of the semaphore in starting or to resist its momentum in stopping; it is for this latter reason, probably, that the semaphore is not used where the propelling force is a weight, made active through the instrumentality of an electric current and an electro-magnet.

This applies principally to high-speed signals. For low-speed signals to govern shifting operations, or what are known as reverse movements, it has hitherto been customary to use a low-disc signal, commonly termed a pot signal; but more recently there is a marked tendency towards the use of dwarf semaphores for this purpose. The almost universal custom in this country is to hang the semaphore blade so that it will point to the right when viewed from an approaching train which it governs. The Boston & Albany is the most notable exception.

NIGHT SIGNALS.

The semaphore signal by night has generally been interpreted by means of lights, red corresponding to the danger position, and white to the clear position. Under these conditions the semaphore, although a position signal by day, has become a color signal by night. Some effort has been made to secure the successful introduction and use of position signals by night. The Boston & Albany have accomplished this by the expedient of equipping each semaphore signal with three lights so connected that when the blade is in the horizontal or danger position, two lights, in the same horizontal line, are displayed while with the blade hanging down in the clear position, two lights in the same vertical line are displayed. More recently, on other roads, illuminated semaphores have been devised and introduced, accomplishing the purpose of illuminating the semaphore blade by night, and changing the color of the illumination from red to white, as the blade is shifted from the danger to the clear position

MEANS OF OPERATING SIGNALS.

The means of operating signals are numerous, the simplest being the rope or chain for operating a block or train order signal at a station. Signals located at a distance from the point of operation may be worked by manual power through pipe or wire connections, or by a weight set in action by electricity, or by compressed air, which is also applied by electricity. When manual power is used to operate signals, the connections are almost always of wire, which is much lighter and cheaper than pipe.

Formerly the connections for operating a distant signal were limited to a single wire, used to pull the signal blade to clear, the counterweight at the signal post being relied on to restore the signal to danger. Each such signal wire was provided with an adjusting screw located conveniently to the operator, by which the wire could be lengthened or shortened to suit the conditions of temperature.

Dangers from neglect of adjustment and from occasional failure of the counterbalance to restore the signal to danger, led to the introduction, and now general use, of two wires for the operation of each semaphore. This was followed by efforts to introduce automatic compensators into the two wire system of connections. In general these were expensive, and sometimes dangerous; as when a certain one of the two wires broke, in which case the signal might be left in the clear position.

It subsequently developed that with two wire connections it was entirely practicable to omit all automatic compensating devices, and such is now the very general practice. Both wires are fitted with adjusting screws, which need to be used only between extremes of temperature. Ordinary slight variations of temperature result in no movement of the signal blade, as both wires are affected equally. Neither are the wires thus subjected to any undue strains; in their natural condition they are full of kinks, which give and take enough to more than accommodate the alteration of length due to changes of temperature such as occur in practice.

The use of a weight to operate a signal has been generally limited to revolving disc signals, and has not been favored as a means for operating semaphores. The electric current acting through an electro-magnet is used to release and set in action the weight, which then effects a quarter turn of the vertical spindle of the signal, changing the signal disc from danger to safety, or from safety to danger. Compressed air is most successfully used to operate signals of the semaphore type, es-

Railway Companies having Freight Cars Equipped with the Westinghouse Automatic Brake.

(The second column gives the mileage of railway operated by each company. If the company has adopted the Westinghouse automatic brake for all new freight cars, this mileage is repeated in the *third* column. If the total number of cars owned by the company equipped with the Westinghouse Automatic Brake exceeds half the number of miles operated, the mileage is repeated in the *fourth* column.

If adopted on some cars or in use on a number of cars less than half the number of miles controlled by the company, the mileage is repeated in the *fifth* column. If adopted or in use on special classes, the *sixth* column states what classes. If applied to cars sent to shop for general repairs, the mileage is repeated in the *seventh* column. The *eighth* column gives the number of cars owned by the company equipped with the Westinghouse automatic brake.]

MILEAGE APPEARING IN THE THIRD AND FOURTH COLUMNS IS SHOWN ON MAP IN SOLID LINES.
" " " " FIFTH COLUMN " " " " " DOTTED LINES.
NO OTHER MILEAGE THAN THE ABOVE IS SHOWN IN GREEN.

Name of Railway	Mileage operated.	Adopted for all new frt. cars. Miles.	No. cars in use more than half the No. miles operated, Miles.	Adopted or in use on some cars. Miles.	On what classes.	Adopted for cars sent to shop for general repairs. Miles.	Whole No. of cars equipped.	Remarks.
Atch., Top. & Santa Fe	7,122	7,122				7,122	20,000	
Atl. Coast Line	958			958			450	
Atl. & Pac.	815		815				850	
Balt. & Ohio	1,825			1,825	on 54 Refrigerator		54	
Burl. & Mo. R. R. R. in Neb	2,754			2,754			1,200	900 Longbridge Straight Air in use.
Burl.,Ced. Rap. & No'n	1,046							
Chesapeake & Ohio	910			910	Exp. Frt. Box		200	Only a few on Exp. Freight cars.
Chic. & Alton	849		849		Stock and Fruit		450	
Chic., Mil. & St. P.	5,678			5,678			200	
Chic. & No'w'n	4,250			4,250	Stock, Refr't Line		1,165	
Chic., Burl. & Quincy	2,140		2,140				1,140	
Chic., R. I. & Pac.	2,775	2,775					1,550	Foundation gear applied to all new cars and all cars sent to shop for general repairs.
Cleve., Col., Cinn. & Ind. and Ind. & St. Louis	742			742	Std. Stock		280	
Colo. Midland	209	209				209	837	
Denv. & Rio Grande	1,482	1,482				1,482	1,200	
Rio Grande Western	302	302						On all broad gauge cars.
Denv., Tex. & Ft. Worth	853		853				282	All present equipment (N. G.) has West. Straight Air.
Duluth & Iron Range	119	119					1,122	
K. Cy., Ft. Scott & Memphis	914			914	100 logging cars		100	
Fitchburg	309		309				576	These cars are all on Current River R. R.
Grand Rap. & Ind.	558			558			10	
Hannibal & St. Jo.	292			292			10	
Houston & Tex. Cen.	790			790			125	
Intercolonial.	906			906			350	
Kanawha & Ohio	126			126			20	
Kan. City, St. Jo. & C. B.	314			314			30	
K. Cy., Wy. & N. W.	160			160			240	
Louisville & Nashville	2,614			2,614			23	
Mex. International	395	395						
Mexican Pac.							100	[Road under construction.
Mich. Central	1,508		1,508				994	
Mil., L. S. & W'n	650			650			281	
Mobile & Ohio	685			685			300	
N. Y. C. & H. R. R.	1,421			1,421			350	
New York, Chicago & St. Louis	524	524					150	
New York & New England	446			446	Exp. freight		63	
New York, L. E. & Wn.	1,215			1,215	All new box		581	
N. Y., N. H. & H.	508			508			100	
N. Y., Ont. & W'n	424			424			26	
New York, Penn. & O.	581			581	All new box			
No. Pac.	3,506	3,506					5,780	
Old Colony	587	587					185	
Ore. Ry. & Nav. Co.	855		855				600	
Penn. E. of Pitts & Erie	3,680		3,680		All new box and stock	on 50 refr't and 50 stock	2,281	
" W. " " " (Southwest System)	1,462		1,462		All new box and stock,		1,150	
Penn. E. of Pitts. & Erie (Northwest System)	1,048		1,048		All box stock and refr't.		1,482	
Phila. & Reading	940			940	Cars in con'str'n trains		87 (about)	
Phil., Wil. & Balt.	648			648			242	
Pitts. & W'n	372			372			99	
Raleigh & Gaston and R. & A.A. L.	210			210	on fifty 50,000 lb. box		50	
Richmond & Danville	2,850	2,850			All except coal cars.	expect to do so	*2,400	
St. Jos. & Grand Island	448	448					900	
St. L., Ark. & Tex.	1,287							On fruit express cars in passenger service.
St. Paul, Min. & Man.	3,024			3,024			350	
Seaboard & Roanoke	111			111			55	
Seattle, L. S. & En.	80		80				91	
So. Pac. Co.: Pac. System	4,250	4,250				4,250	12,043	
" " " Atl. System	1,700	1,700					2,000	
Spokane Falls & No'n	120	120					75	Road under construction.
Tex. & Pacific	1,497			1,497			40	
Toledo, Peoria & Wn.	247			247			56	
Union Pacific	4,895	4,895					12,902	
Wabash	902			2	Box, stock and fruit		400	
West Shore	448						213	
Merchant's Despatch							300	
Private Companies' Cars							6,217	
	85,634	31,443	13,749	38,160		13,132	85,365	

pecially when the valve controlling the admission to and exhaust from the signal cylinder is operated by an electric current and electro-magnet; this combination provides a means whereby a sufficient force for the operation of a semaphore can be instantly brought into play at any desired distance from the operator.

OPERATING SWITCHES.

Switches are operated either by manual power or by compressed air. If manual power is used, the connections are generally of pipe, which is preferred on account of its lightness, stiffness, and the possibility of its exact compensation. It is stated that the London & Northwestern Railway is now using a light channel iron as a substitute for pipe connections. It is entirely possible to operate switches by wire rope connections, but while this method is sometimes resorted to in special cases, its use is a very decided exception to the general practice.

THE ORIGIN OF INTERLOCKING.

No doubt personal convenience first prompted the assembling of switch and signal levers in groups, although economy of time was one of the immediate resultant benefits. But there was undoubtedly an element of danger in such an arrangement, which led to occasional mishaps, and emphasized the need of some mutual interaction between the several levers which would prevent the formation of such combinations as might result in accidents. Thus gradually developed the art of interlocking, which has now attained a high degree of perfection.

The feature of preliminary interlocking has been referred to as one of our inheritances from English practice. Its principle may be stated as follows.

A lever which is to lock certain levers and release certain other levers must complete all its locking functions before the beginning of its stroke, and must not accomplish its releasing or interlocking functions until after its stroke is completed.

The spring-catch affords the means by which it is possible to meet these conditions; and it is now invariably used to actuate the interlocking mechanism. The result is that the interlocking mechanism receives an initial movement prior to the stroke of the lever, is maintained in a state of rest during the stroke of the lever, and receives a final movement after the stroke of the lever is completed. These features of interlocking are common to all successful machines, although the means by which they are accomplished may differ.

(TO BE CONTINUED.)

The Progress in the Use of Automatic Couplers and Air Brakes on Freight Cars.

(With Inset Map.)

For the past two score years there has been no scheme over which so many inventors in this inventive land have racked their brains as the problem of an automatic car-coupler.

Very many people believe this problem to be a still unsolved and probably unsolvable one. Very many railroad men even, we are sorry to say, still labor under the impression that the action of the Master Car Builders' Association in 1887 in adopting a standard type of automatic coupler has had little eff

Railway Companies having Freight Cars Equipped with Automatic Couplers.

(The *second* column of the table gives the mileage operated by each company. If the company has adopted the Master Car Builders' Standard Coupler for all new freight cars, its mileage is repeated in the *third* column. If the M. C. B. Std. coupler is adopted on all new box and stock cars, or if the total number of cars equipped with the M. C. B. coupler is more than half the number of miles controlled by the company, the mileage is repeated in the *fourth* column. If adopted on some cars or in use on a number of cars less than half the number of miles controlled by the company, the mileage is repeated in the *fifth* column. If adopted or in use on special classes, the *sixth* column states what classes. If applied to cars sent to shop for general repairs, the mileage is repeated in the *seventh* column. The *eighth* column gives the number of cars owned by the company equipped with the M. C. B. Std. coupler. The *ninth* column gives the number of cars owned by the company equipped with any automatic coupler not M. C. B. Std.)

MILEAGE IN THE THIRD AND FOURTH COLUMNS IS SHOWN ON MAP IN SOLID LINES.
" " " FIFTH COLUMN " " " " " DOTTED
NO OTHER MILEAGE THAN THE ABOVE IS SHOWN IN RED.

Company.	Mileage. Controlled.	Adopted for all new frt. cars. Miles.	Adopted for all new box and stock cars or in use on many cars. Miles.	Adopted on some cars. Miles.	Adopted or in use on what classes.	Applied to cars sent to shop for general repairs. Miles.	No. cars equipped with M. C. B. Std. coupler.	No. with any other automatic coupler.	Remarks.
Ala. Midland	175		175				450		Road under construction.
Allegheny Valley	259	259				259	350		Have adopted Janney.
Atchison, Top. & S. Fé	7,500	7,500					3,000		"Are putting on Dowling."
Atlantic Coast Line	850		850				1,300*		*Janney couplers.
Baltimore & Ohio	1,825			1,825	250 refrigerator, 100 Eastman heater, 25 stock.		375		Stock cars have Dowling.
Buffalo, Roch. & Pitts.	284							500	C. W. Mills automatic hook.
Burl. & Mo. River	2,754			2,754	1,000 box; 100 stock.		1,200		
Burl., Cedar R. & No'n	1,046								Trying a few Knowlton couplers.
Cape Fear & Yad. Valley	245	245					160		
C. R. R. & B. Co. of Ga.	1,624		1,624		700 fruit; 300 coal cars.		3,400		Will also replace broken drawheads with M. C. B. coupler.
Chesapeake & Ohio	910			910	100 Ex. frt. box.		110		
Chic. & E'n Ill	432								"We are putting on Perry & Safford link and pin."
Chic. & No'w'n	4,250	4,250					1,310	853*	*Automatic link on ore cars.
Chicago & West Mich	408							100	
Chicago, Burl. & Q.	2,140			2,140	45 coal, 225 stock, 50 grain, 5 fruit.		845		"Would not think of considering anything but M. C. B. Std."
C. R. I. & Pac	3,000	3,000					2,200		
C., St. P., Minn. & O.	1,500								Will probably adopt M. C. B. Std. when new cars are built.
Choctaw C. & I. Co.	15		15				100		Road under construction.
C. C. C. & St. L.	1,528		1,528			1,528*	1,800	1,430*	*On std. box and stock. †Marks.
Cleve., Lorain & W.	164							64	Marks.
Conn. R. and Vt. Valley.	130							130	Hitchcock coupler, pat. March 18, 1884.
D. & H. Canal Co.	700							2,800	Marks automatic is put on all new cars and all cars sent to shop for general repairs.
Det., Lansing & No'n	324							100	
East Tenn., Va. & Ga.	1,620	1,620				1,620*	2,500		*On cars sent to shop for general repairs of 40,000 lbs. cap. or over.
Fairhaven & Southern	30		30				50		Road under construction.
Fall Brook Coal Co.	250	250				250*		580†	*On gondolas repaired only. †Ames, being replaced with Gould.
Fitchburg	370							100	
Flint & Pere Marq.	380							3,253	Marks.
Georgia	307						100		
Ga. Midland & Gulf	98							135	"All our cars have Brooks' pin and link automatic coupler."
Ga. Southern & Florida	285		285				500		
Grand Rapids & Ind.	558			558			225		
Grand Tr'k (Mich. lines).	801			801	In use on 13 furniture cars.		13	333	Are putting McCree & Aikman coupler on all new cars and all sent to shop for gen. repairs.
Jacksonville So'e'n	310	310					100		
Lake Shore & Mich. So'n	1,341		1,341				1,700		
Lehigh Valley	825		825				1,350		
Long Island	357							248	Marks.
Mich. Central	1,537			1,537			165		
Mil., L. S. & W'n	600			600	On 10 new coal cars.		10	1,390*	*Equipped with Blocker coupler; are putting it on all new cars.
Mineral Range and Hancock & Calumet	40								Are putting Blocker coupler on all new cars and some cars sent to shop for gen. repairs.
New Brunswick	500	500					500		
N. Y., Chic. & St. L.	524	524					160		On 150 refrigerator cars.
New York & New Eng.	446			446	On 109 local box.		109		
N. Y. C. & H. R. R.	1,420		1,420				8,000		
N. Y., L. E. & W'n	1,215	1,215				1,215	3,745	425	
N. Y. P. & O.	581	581				581	133	998	
N. Y., Ont. & W'n	418			418			50	54*	*Marks.
N. Y., Phila. & Norfolk	112		112				90		
Old Colony	597							500	Are putting Safford coupler on all new cars and all cars requiring new drawbar.
Oregon & Wash. Ter.	125		125				72		
Pa. (W. of P'b'g and Erie)	2,510		2,510		On all new box and stock		5,534		
Pa. (E. of P'b'g and Erie)	3,680		3,680		On all new box and stock	3,680*	3,304		*On 50 refrigerator cars.
Penna., Pough. & Boston	76		76				250		
Phila., Wil. & Balt.	519		519				660	40*	*Marks.
Pitts. & Western	360							1,500	Putting on some Haselton couplers.
Pontiac, Ox'd & P. Austin	100							2	Putting Blocker coupler on all new freight cars and all cars sent to shop for gen. repairs.
Raleigh & Gaston and Raleigh & Aug'ta A. L.	210			210	On 50 50,000 lb. box.		50		
Richmond & Danville	2,850		2,850		On all except coal cars.	2,850*	3,857		*On all standard box and stock.
Rio Grande W'n.	375			375			100		On new std. gauge cars.
Rome, W. & Ogdensburg	643		643				440		
St. L., Alton & Spr.	89	89					50		
Seaboard & Roanoke	80		80				80		
Toledo, Ann A. & N. Mich	302							165	Are putting Blocker coupler on some new cars
Tucson, Globe & No'n	10		10				32		
Wabash	902			902			60		We prepare all cars rebuilt for automatic couplers.
Western N. Y. & Pa.	669		669				2,050		
West Shore	965			965			400		
Private Co.'s Cars and Car building Cos.							3,061	40	
Totals	62,040	20,343	19,365	14,441		11,983	56,050	15,755	

toward unifying practice, and that the equipment of the bulk of our freight cars with automatic couplers of any type, though desirable enough in the abstract, is not likely to be accomplished for a generation to come.

We are very happy to present in this issue to such ill-informed persons, as well as to those enterprising workers who have been prominent in pushing the reform, a complete statement of the progress made to date by the several railroad corporations of the country in equipping their freight cars with automatic brakes and couplers. We present it in such a shape, moreover, that he who runs may read the main facts, and may also, at his leisure, obtain all the details of the progress of this most important reform.

The figures given in the accompanying tables are mostly compiled from reports made directly to us by the chief mechanical officers of the various companies, supplemented by data furnished by the principal makers of brakes and couplers.

An examination of our map and tables shows that the principal railways on which the air brake is in extensive use are the Transcontinental roads, the Chicago systems, the Richmond & Danville in the South, and the Pennsylvania, Erie, Michigan Central, Fitchburg, and Old Colony among prominent Eastern roads. Besides these, our table shows 38,000 miles of railways on most of which the use of the brake has passed the experimental stage and a considerable number of cars are in use.

The M. C. B. Std. coupler is coming into use much faster in the East than in the far West. The

Trunk line roads, the Chicago systems, and the Richmond & Danville and Atlantic Coast line in the South are the chief movers in this reform. The manner in which these two latter companies have pushed the work of equipping their cars is much to the credit of their chief mechanical officers. The delinquency of other important Southern systems, however, is very noticeable. In the Southwest practically the only mover in the reform is the Atchison system. We are informed, however, that the Missouri Pacific has recently equipped a few cars with air brakes, and we trust that this may indicate their adoption as a permanent policy.

New England does not show up at all creditably. The Fitchburg, the Old Colony, the New York & New England, and the New York, New Haven & Hartford are the only companies which have made a start. However, this is not the only detal of railway practice in which New England railways are sadly behind the times.

We have included in our table the companies using any automatic couplers of a type other than the M. C. B., although no roads not using the M. C. B. type on some cars are shown on the map or included in the totals. The roads which still cling to the automatic link type, with a stubbornness worthy of a better cause, are most of them of local importance merely. The Old Colony and the Delaware & Hudson Canal Co. are the most prominent. We trust that a careful examination of our tables, which show about four M. C. B. couplers to one of any other automatic type, whereas two years ago the latter far outnumbered the M. C. B. coupler, will convince the most skeptical that the automatic link coupler must yield the field to the type selected by the Master Car Builders' Association. If anything further is needed to prove the supremacy of the M. C B. type, the fact which we elsewhere p int out, that about 40,000 cars have been equipped with M. C. B. couplers during the present year, should suffice to settle the question.

As regards the use of the air brake on freight cars, there is a current opinion that, while they may be well enough on the transcontinental lines where grades are long and steep, wages of trainmen are high, and traffic is mostly long haul, for roads in the East, there is not much to be gained by their use.

We have elsewhere pointed out the great economy which attends their use on the average road, and the great need for them on the score of humanity, since, while trainmen are most frequently injured when coupling cars, the greater proportion of deaths are due to overhead bridges and falling from trains. The salient point which may be noted by our map and tables is, that the brake is making rapid progress not only on the transcontinental lines, but on the trunk lines, on the systems west and northwest of Chicago, and in the South. The Pennsylvania has about 5,000 cars equipped, the Richmond & Danville 2,400, the Michigan Central 1,000. Such extensive use, and the fact that the roads which have had the longest experience with the brakes under the severest conditions are applying them to all new freight cars, is proof enough of the advantages attendant upon their use.

On the whole, the showing made for both brakes and couplers is a most gratifying one to all true friends of the reform. Large bodies move slowly, especially at the start; and to bring automatic freight brakes and couplers into use on all the railways of the country is to cause the movement of a very large body of busy men on the line of reform. But the greatest friction, in moving mind as well as matter, exists at the start; and with such good progress already made as that we have shown, the ultimate and early success of the movement is assured.

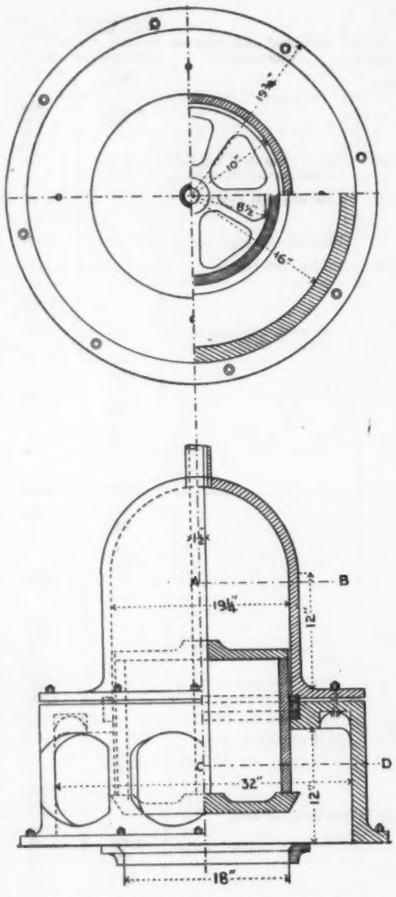
A New Stop Valve.

A novel type of water-valve is described to us by a correspondent and illustrated in the accompanying cut.

This valve has a solid dome resting on a perforated ring, with packing between them in a bevelled notch, as shown in the engraving. Within the dome is a solid cylinder having two perforated heads connected with a shaft, and with a valve-seat at the bottom, ground to fit the lower edge of the cylinder.

The action of the valve is described as follows: When open the water enters through the perforated ring and flows under the lower cylinder-head to the outlet below. When the valve is shut down on its seat, the water presses against the outside of the cylinder, but the packing referred to keeps it from entering the dome, which latter is full of air. If any water should leak through the packing, it runs out through the openings in the cylinder heads and can never fill the dome.

The advantage claimed for this form of valve is, that the weight to be lifted in operating the valve is only the weight of the shaft and cylinder, irrespective of the head on the valve.



The Land and Hawks Stop Valve.

This may be more clearly understood by recollecting that the pressure of the head of water when the valve is shut is against the vertical sides of the cylinder which forms the gate, and its only effect is to bring an equalized external pressure upon it, acting in a horizontal plane. There is no vertical force whatever upon the cylinder from the head of water above.

In this particular valve the pipe from the lower side of the valve leads to an open nozzle, and hence no pressure whatever is exerted upon the valve from this side; but even if the valve were placed in a water main where the pressure might be as great on one side as on the other, the head of water on this lower side would exert an equal pressure in the top and bottom heads of the cylinder and would thus have no effect on the opening or closing of the valve.

We see no reason, however, why the valve would not be applicable to many localities where heavy water pressures make valves of the ordinary type difficult to handle. The only trouble which we apprehend in such use would be the sharp turn which the flowing water has to make, and the possibility, where the device is used with a head of water on its lower side, that the water which would then fill the dome might be likely to freeze in cold weather.

This valve was designed by Messrs. Land & Hawks, hydraulic engineers of Denver, Col., for a placer mine which is to be worked under a head of water of 250 ft.

Certainly the device is well worth examination by hydraulic engineers, especially those who are handling water under heavy pressures; and if anyone has any comments or criticisms to make on the device the engineers above referred to would doubtless be pleased to receive them.

PERSONAL.

Mr. C. S. MELLEN has been appointed General Traffic Manager of the Texas Pan Handle route, with office at Omaha, Neb.

Mr J. C. STUBBS has been made fourth Vice-President of the Southern Pacific Company, having charge of the traffic department.

Mr. PATRICK RYAN, Master Mechanic of the Owensboro & Nashville, has been appointed to a similar position with the Kentucky Union.

Mr. RUFUS MARTIN, of New York, dealer in railway supplies, was thrown from his carriage last week and received injuries from which he died.

Mr. JAMES R. MAXWELL, Consulting Engineer, has removed from Hamilton, O., to Cincinnati, O. His office is at 217 Main St., Cincinnati.

Mr. JAMES SHANAHAN, Superintendent of Public Works of New York State, has resigned. He will carry on a quarrying business at Tribes Hill, N. Y.

Hon. JONATHAN CHACE has been elected President of the Board of Directors of the Water-Works, at Westerly, R. I., vice Hon. JAMES M. PENDLETON deceased.

Mr. HENNESSEY, of the Nicaragua Canal party, committed suicide on Nov. 21, by shooting, while partly delirious from fever. He was buried at Greytown.

Mr. L. M. MARTIN has been appointed General Manager of the Des Moines & Northern in charge of traffic and operating departments, with headquarters at Des Moines, Ia.

Mr. R. F. HARTFORD, C. E., of Chattanooga Tenn., has been engaged to prepare plans for the sewerage of Fort Payne, Ala. A sewage disposal plant will be an important feature in the system.

IT is reported upon reliable authority that Mr. JOSEPH F. TUCKER, the Assistant General Manager of the Chicago, Milwaukee & St. Paul, will be appointed General Manager of the Illinois Central. Mr. TUCKER was at one time Traffic Manager of the Illinois Central.

Mr. MINOR SCOVEL has resigned the position of President of the Scovel & Irwin Construction Co., of Nashville, Tenn., to become Consulting Engineer for the company. He has opened an office in Nashville as an engineer for blast-furnaces, water-works, and sewerage systems.

Mr. J. B. CONNORS has been appointed Superintendent of the Toledo, Ann Arbor & North Michigan Co's. lines, with headquarters at Owosso, Mich., and Mr. M. S. CONNERS, his brother, has been appointed Superintendent of the Cincinnati, Hamilton & Dayton, and Cincinnati, Hamilton & Indiana, with headquarters at Cincinnati.

Mr. W. W. STARR, of the Southwestern Railroad of Georgia, has been appointed Superintendent of Transportation of the Georgia Central system, with offices at Savannah, Ga. This is the position recently resigned by Mr. EDWARD TYLER, and which Mr. D. W. C. ROWLAND, late Superintendent of Transportation of the Louisville & Nashville, accepted a few weeks ago, and which he has now resigned.

Mr. M. J. MCINARNA has resigned his position as Roadmaster on the New York, Pennsylvania & Ohio Railroad to accept the position of Inspector of Railroads and Bridges for the State of Ohio by the Railway Commissioners. The appointment is an unusually good one. Mr. MCINARNA was one of the most trusted assistants of the late CHARLES LATIMER, and has had twenty-six years' experience with practical track work, having held the position at the early age of twenty-three. During his seventeen years of service on the N. Y. P. & O. we understand that not a wheel came off and not a passenger was injured on his division through fault of track. We have no doubt he will make a valuable officer in his new position.

Major O. E. MICHAELIS, U. S. A., and commandant of Kennebec Arsenal, nearly lost his life on Dec. 1 in the unhappily vain attempt to save the life of his little daughter who had broken through the ice on a pond. Two of his children, a boy and a girl, ventured out on the thin ice, which broke with them, and another son ran to notify the father. Major MICHAELIS also broke through in the attempt to rescue his children, and though he made a desperate effort, he himself became insensible, and was only saved from a like fate with his

daughter by Private GETCHELL, of the post. The boy clung to a plank and was rescued. Major MICHAELIS will have the sympathy of a very wide circle of friends in his bereavement.

Mr. MARK D. HANOVER, C. E., of Brooklyn, N.Y. died Dec. 14. He was born in Connecticut about fifty-two years ago. His college preparatory course was taken at Wesleyan Seminary, Wilbraham, Mass., and he was graduated as a civil engineer from Union College in 1858. He practised his profession in Mississippi for some time, and then returning to the North, began the study of law at Geneseo, N. Y. After being admitted to the bar he removed to Cincinnati and practised law. He was the founder of the Cincinnati *Star*. For some years past he had practised law in New York, and was Eastern agent for several leading Western papers. He was also interested in water-works projects, both in construction and financiering.

Mr. FRANKLIN B. GOWEN, formerly President of the Philadelphia & Reading Railroad, committed suicide at Washington, on Dec. 14. He was born in Philadelphia, Feb. 9, 1836. In 1858 he entered into the business of mining coal, which he soon abandoned in order to study law. He was admitted to the bar in 1860, beginning practice in Schuylkill. In 1862 he was elected district attorney of Schuylkill County. On resuming his general practice at the bar he was retained as counsel for the Philadelphia & Reading Railroad, and of the Girard coal trusts, in connection with their large interests in the mining region. From 1869 to 1881 he was president of the Philadelphia & Reading, but in the latter year, because of opposition to his plans for the relief of the finances of the road, he failed of re-election; in 1882 he was again made president.

SOCIETY PROCEEDINGS.

The American Society of Civil Engineers.—Regular meeting of Dec. 18, Mr. C. B. BRUSH presiding. The death of Mr. H. F. CRAVEN, Mem. Am. Soc. C. E., was announced. The Secretary stated that the annual meeting of the Society would convene at the house of the Society on Wednesday, Jan. 15, and that on one of the evenings of the session a reception would be given to the Society by the Engineers' Club of New York.

The paper of the evening was by Mr. FRANZ A. VELSCHOW, C. E., of Copenhagen. The subject was "The Cause of the Trade Winds," and a theory was advanced by the speaker to account for their prevailing direction and position. A large map showed the lines of barometric pressure on a Mercator's projection of the earth's surface, and the speaker pointed out the existence of five anti-cyclones, with centers of high pressure and a circuit of prevailing winds. All of these occur at about the centers of the five great oceans of the globe. To the east of each one of these centers of high pressure lies an area of desert or arid land producing heated currents, and it was these areas, with prevailing westerly winds blowing over them and carrying off the hot air, that, according to the speaker's theory, produced the prevailing air currents noted. The great Desert of Sahara, with westerly winds blowing over it for nine months of the year, was supposed to be the cause of the trade winds of the North Atlantic; and it was the warm wind from this same source that came up our coast on its way to Europe. This was the general statement of Mr. VELSCHOW, but to explain more fully his theory and the reasons why these winds followed certain paths would require diagrams and more space than is at our disposal here. In connection with this subject, the speaker noted the effect of large areas of hot, desert land upon the air currents, and stated that over such land there was practically a cushion of dry, heated air, which transformed into vapor all precipitated moisture from higher air currents, and sent this vapor off with the prevailing wind. He suggested as a remedy in Australia, a point he had studied with reference to irrigation, that plantations of trees be started of species that would give off moisture to the air. The indigenous trees and plants of Australia are of kind that show no exhalation, and are enabled by their hard, glazed leaves to flourish in this dry air by keeping stored up the moisture within them. But trees with high evaporative qualities do flourish there when planted in moist ground, and a decided increase in the area covered by them would have a tendency to furnish moisture and destroy to some extent the cushion of dry air existing. Messrs. MACDONALD, BRUSH, and others discussed or commented on the speaker's theories.

Engineers' Club of Philadelphia.—Record of business meeting, Dec. 7, 1889. President WILLIAM SELLERS in the chair; 29 members and 2 visitors present. The Secretary presented a report from the Committee on Highway Bridges.

Mr. GEO. BURNHAM, Jr., described the spirally welded steel tubing made at East Orange, N. J., exhibiting a length 10 ins. diameter by 9 ft. 5 ins. long. The pipe is made as follows: A ribbon of skelp of the desired width and length is fed to a guide table at the proper angle with the axis of the pipe machine. This machine, operated by a belt from a countershaft, automatically winds the skelp into a spiral tube. The incoming edge of the skelp passes through a small furnace about a foot square, enclosing a blow-pipe flame of water-gas and air, which heats both edges of the pipe to a welding heat. A small hammer, with a rapid action, welds the overlapping edges as the pipe feeds forward. The pipe is stiff and light, and is said to be very strong, the usual gauges of stock used being from 16 to 14 B. W. G., for pipes from 6 to 24 ins. diameter. It is used for conveying gas, water, steam, etc., at the usual pressures required. There was considerable discussion of this contribution and of other matters of interest connected with pipes and joints. Mr. A. P. BROOMELL presented an illustrated paper upon a new system of street car propulsion.

HOWARD MURPHY,
Secretary and Treasurer.

Association of Civil Engineers of Dallas, Tex.—At the recent annual meeting the following officers were elected to serve during the ensuing year, viz: W. J. SHERMAN, President; W. WERENSKIOLD, Vice-President; J. S. THATCHER, Director; E. K. SMOOT, Secretary; J. D. TRAMMELL, Treasurer; W. L. EUSTIS, Librarian. The officers' reports showed the affairs of the association at the end of the first year of its existence to be in a flourishing condition.

Engineering Association of the Southwest.—The December meeting was held at Nashville, Tenn., on the evening of 12 inst. President JOHN MACLEOD of Louisville, Ky., presided, and about 30 members, representing the States of Tennessee, Kentucky, and Alabama, were present. The Standing Committees on Finance and on Rooms and Library submitted reports. The latter committee reported the selection of permanent quarters still undetermined.

The policy to be adopted by the Committee on Papers and Printing was discussed, and that committee is expected to report a definite plan of receiving and announcing papers and discussions at the next monthly meeting on Jan. 9.

The Secretary was instructed to prepare and print catalogue of the original members, the only ones received and who number over 60 and represent ten Southern States. The Association is now preparing to receive members into the three grades of Member, Associate, and Junior, through the usual channels of application for membership.

The paper of the evening on "The Use of the Slide Rule by Engineers and Architects," was then read and fully illustrated by Mr. EDWIN THACHER of Louisville, Ky. A full exhibit of the many forms of this instrument was made a part of Mr. THACHER'S paper and the principles and methods of use of each were developed. At the close of the paper and its discussion, Mr. C. A. TURRELL, of Toledo, O., exhibited the working of a Mental Slide Rule which attracted much attention. Until its permanent quarters are fitted up, the Association will meet in its present quarters, viz., the assembly room of the new Y. M. C. A. Building.

O. H. LANDRETH, *Secretary.*

New England Water-Works Association.—The quarterly meeting and dinner were held at Young's Hotel, Boston, last week, and were attended by about 100 members. The dinner was served in the large club room at 1 o'clock. About 1½ hours later President DEXTER BRACKETT, of Boston, called the assemblage to order and opened the business meeting.

A number of members volunteered to read papers at the next meeting, which will be held at Young's Hotel on Jan. 8, and then Vice-President HAWES, of Fall River, described the trip that the association took to the White Mountains last fall. Mr. JOHN R. FREEMAN, the engineer of the Associated Factory Mutual Insurance Co., read a paper on "Experiments on Practical Tables Relating to Fire Streams." He said that such fires as those recently suffered by Lynn and Boston were the final tests of the value of water-works. Any man who would lay a 4-in. main near a factory ought to be hanged. He argued against the use of what are known as "ring nozzles" by departments, and urged the importance of using smooth rubber-lined hose. He thought the standard size of fire hose should be increased, for a change from 2½ to 2¾ ins. in diameter would decrease the friction 25 per cent. He said that the lesson of the recent fires was wholly in favor of larger streams, and that the time was coming when a larger supply of water would be required for a standard fire stream. He compared the London fire department unfavorably with those in the large cities in this country, and said that in Berlin firemen played through ¾-in. nozzles. In the latter city the steamers are never called out until after the hand engines had tried to put out the fire and failed. This seems very funny, he remarked, but the laugh is on us rather than on the foreigners. They prevent fires by their building laws, something that we do not do. He suggested that in playing on a fire from a long distance, engines use two lines of hose, uniting them by a Siamese coupling near the fire. By using this method, the stream of an engine 1,000 ft. from a fire would lose only the same amount of force and volume as it would lose under ordinary conditions when 250 ft. away. There is a loss of 6 per cent., he said, from laying hose in the ordinary serpentine form, over what there would be if the hose were laid in a straight line.

Several members of the association took part in the discussion of Mr. FREEMAN'S paper, and he was called upon to answer a number of questions. Mr. BRACKETT said that there was water enough used at the Boston fire to cover the whole area burned 10 or 12 ft. deep. Mr. HASKELL, of Lynn, described that city's water-works, and said that, as near as it could be estimated by the record at the pumping station, 8,280,285 galls. of water were thrown on the fire there during the first twenty-four hours of its duration. During the fire no pipes burst, and there was nothing to interfere with the free circulation of the water.

During the meeting several vocal duets were given by Messrs. FRANCIS L. PRATT and G. FRANK MONROE, and the meeting closed with the singing of "Mary Had a Little Lamb."

The following new members were elected: Active resident members: ELMER E. FARNHAM, Superintendent of Water-Works, Sharon; CHARLES F. PARKS, Civil Engineer, Boston; WILLIAM WHEELER, Civil Engineer, Boston; JOHN W. ELLIS, Water Commissioner, Woonsocket R. I.; JOHN C. HASKELL, Superintendent of Water-Works, Lynn; W. H. VAUGHAN, Superintendent of Water-Works, Wellesley Hills. Non-resident active members: EDWARD M. BOGGS, Hydraulic Engineer, San Bernardino, Cal.; WILLIAM F. DAVIS, Superintendent of Water-Works, Sherburne, N. Y.; J. E. DENTON, Professor of Experimental Mechanics, Stevens Institute, Hoboken, N. J.; E. P. FOSTER, Superintendent of the Santa Ana Water Co., San Buenaventura, Cal.; HARRY G. KOCH, Superintendent of the Castle Creek Water Co., Aspen, Col.; SAMUEL B. LEACH, Civil Engineer, North Tarrytown, N. Y.; C. H. TOMPKINS, Jr., Manager, Idaho Mining and Irrigation Co., Boise City, Idaho.

Western Railway Club.—At the meeting on Dec. 17 a paper was presented on "Joint Inspection of Cars" by Mr. P. H. PECK, Master Mechanic of the Chicago & Western Indiana Railway. The following is a brief summary:

Chicago has become the largest railroad center of the world. The car movement at Chicago has been steadily increasing each year until it is estimated that the interchange now amounts to between 4,000 and 7,000 cars daily; and I think I am safe in saying that 30 per cent. of these cars are more or less defective and require a defect card in transferring. The limited yard room and tracks we have in the city for this vast business makes the inspection of cars both expensive and deficient and keeps a large number of cars out of service in busy times when cars are most needed. It also causes extra switching, involving the blocking of side tracks and the delaying of freight.

The only way, I think, by which we can avoid this trouble is by establishing a system of joint inspection at the different junctions or points of interchange.

In the month of October, 1889, the Belt Line received at nine of the largest junctions 27,282 cars, of which there were notations against 9,123 cars, or 34 per cent. of number received. The per cent. of defects varied at the different junctions from 21 to 62 per cent.

I think the present system defective for the reason that a defective car may go to a road over one line and be unloaded and billed home over one of the other lines, but it will not be received by its own road as the inspectors have no record of it. The cars will then have to go back and be returned to the first line that handled it, thus causing a long delay as the car will have to be traced to find the first route it was transferred to, so as to pass the same inspectors.

An example was then given of a car passing from the C. M. & St. P. to the B. & O, and being sent home by a different route, involving, through a want of coöperation among inspectors of the same company, a needless journey of twenty miles through several busy yards.

The expense that I wish to direct special attention to is in the inspection. Each company now has inspectors of its own at each junction. Both inspectors do the same work, but for two companies. The cost per car for inspection for seven of the eight junctions at Chicago for October, 1889, was from $0.022, the lowest, to $0.036, the highest. At one of the junctions there is joint inspection, and the inspection cost there was only $0.017 per car, showing a saving of one half cent on the cheapest, and $0.013 on the highest junction. I think I am safe in saying that between 35 and 40 per cent. could be saved by joint inspection, and a better service would be rendered; and furthermore, we would not have so many cars out of service.

Joint inspection is working very nicely in Kansas City, St. Louis, Cincinnati, Buffalo, and Detroit. I have corresponded with several heads of car departments of roads entering Chicago, and about all favor it, but do not know of a way to adopt it. I have arranged and adopted joint inspection with the Wabash Railway at Chandler, and I find we have very little trouble and very few delays owing to bad orders. The cost of inspection is much cheaper per car, averaging only $0.016 per car against a general average of $0.026 for same month. In June, with a lighter business, the general average was $0.025 and the joint inspection at Wabash cost $0.019—one cent per car cheaper.

I find on the Belt Line that the average cost per car for inspection is too great compared with the average cost for repairs.

The following shows the cost per car for repairs and for inspection on the Belt Line in three months of 1889.

	Jan.	June	Oct.
Repairs	$0.046	$0.044	$ .033
Inspection	0.031	0.029	0.026
Difference	0.015	0.015	0.007

Under the rules, standards, etc., of the Master Car Builders, the repairs of cars have almost reached the lowest point of economy. But in the present system of inspection in this city, there is large room for increased economy. To gain this economy all heads of car departments will have to unite and adopt suitable rules to govern inspection as has been done in other cities.

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AND

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Coming Technical Meetings.

American Society of Civil Engineers. New York.—Next meeting, Jan. 1. Annual meeting, Jan. 15. Secy., John Bogart, 127 E. 23d St.

Engineers' Club of St. Louis, Mo.—Next meeting, Jan. 1. Secy., W. H. Bryan, 809 So. 7th St.

Western Society of Engineers, Chicago, Ill.—Next meeting, Jan. 1. Secy., J. W. Weston, 78 La Salle St.

Engineers' Club of Philadelphia, Pa.—Next meeting Jan. 4 Secy., Howard Murphy, 1122 Girard St.

Engineers' Club of Kansas City, Mo.—Next meeting, Jan 6. Secy., Kenneth Allen, 200 Baird Building.

New England Railroad Club, Boston, Mass.—Next meeting, Jan. 8. Rooms in the United States Hotel.

New England Water-Works Association.—Next meeting at Young's Hotel, Boston, Mass., Jan. 8.

Civil Engineers' Club, Cleveland, O.—Next meeting, Jan. 14 Secy., C. O. Palmer, 21 Cedar Ave.

New York Railway Club.—Next meeting, Jan. 16. Rooms at 113 Liberty St.

Western Railway Club, Chicago, Ill.—Next meeting, Jan. 21. Rooms in the Phœnix Building.

Engineers' Society of Western Pennsylvania.—Next meeting, Jan. 21. Secy., S. M. Wickersham, Pittsburg, Pa.

Boston Society of Civil Engineers.—Next meeting, Jan. 22. Secy., S. E. Tinkham, City Hall.

AN indignant member of the American Society of Civil Engineers encloses us one of the current ballots for officers of that Society, with the following comment endorsed on it, evidently thinking that any other use of the ballot would be a farce:

> The members have absolutely no choice. The election is determined by the nominating committee, and the casting of a ballot is a mere formal approval. There should be at least twice as many nominations made as there are vacancies to be filled, giving some discretion to the voters.

It is even so. The choice of officers under the present constitution is practically in the hands of the nominating committee, and the choice of the nominating committtee is practically the accident of a moment at the annual convention, unless controlled in advance by some clique, as it very easily can be, and several times has been. It is a great evil, and is doing great and increasing harm to the Society; but a committee is now at work preparing a radical revision which it will probably report some time next spring, correcting not only this but other serious defects of the present constitution, which dates back to the day of small things in 1852, thirty-eight years ago, and has been subjected to almost annual amendment in detail since, until it is about as heterogeneous an instrument as governs any important body on the face of the earth. The committee has wisely taken the first step of simply reporting a codification of this instrument, so as to group the same subjects together in single Articles of several sections, instead of scattering them throughout the instrument, thus enabling the members to see clearly what there is to amend; and no change is made in substance except to amend the amending clause, so that a more complete instrument can be submitted and acted on at next summer's convention, instead of waiting a year for the next Annual Meeting in January, 1891. In such important changes as are under contemplation it is necessary to proceed slowly, to be sure of proceeding wisely; and if our correspondent will possess his soul in patience, we think that a year from now he will receive a very different kind of ballot.

THE Dock Department investigation, that was ushered in with such a very loud braying of trumpets, seems to be progressing towards something very like a fizzle. Mayor GRANT very sensibly concluded that he could not act upon the one-sided examination condemned in our last issue, and ordered that the charges be formulated and the Commissioners be given a chance to state their side of the case. These charges have been made against two of the three commissioners; the third, a Tammany appointee, was excepted. It now appears that, in the first place, the Commissioners of Accounts have no authority under the law to make these charges; and if they had, the specifications given are said to refer to alleged misdemeanors of a period antedating the appointment to office of the present Dock Commission. The Commission evidently intends to make a fight, and as able attorneys have been engaged by them, who will doubtless take a prominent part in the hearing that is to come, the Corporation Counsel will not have things quite so much his own way as in the late "examination."

THE annual car famine is recurring this fall, and is more severe than usual on account of the great grain crop of the West. Doubtless the best cure for this periodical glut of traffic would be a radical one. The trouble does not lie in a lack of cars nearly so much as in the fact that the cars we have lie idle while being loaded or unloaded, perhaps even while their contents are waiting for the market. We need to get more mileage out of the cars we have, as every one acknowledges, but how to avoid those delays on sidings is a question which we in this country have only begun to solve.

Probably the best solution of this knotty problem of freight car detention will yet be found in some radical reorganization, which will involve placing the control of the freight car movement of the country in the hands of a central clearing house.

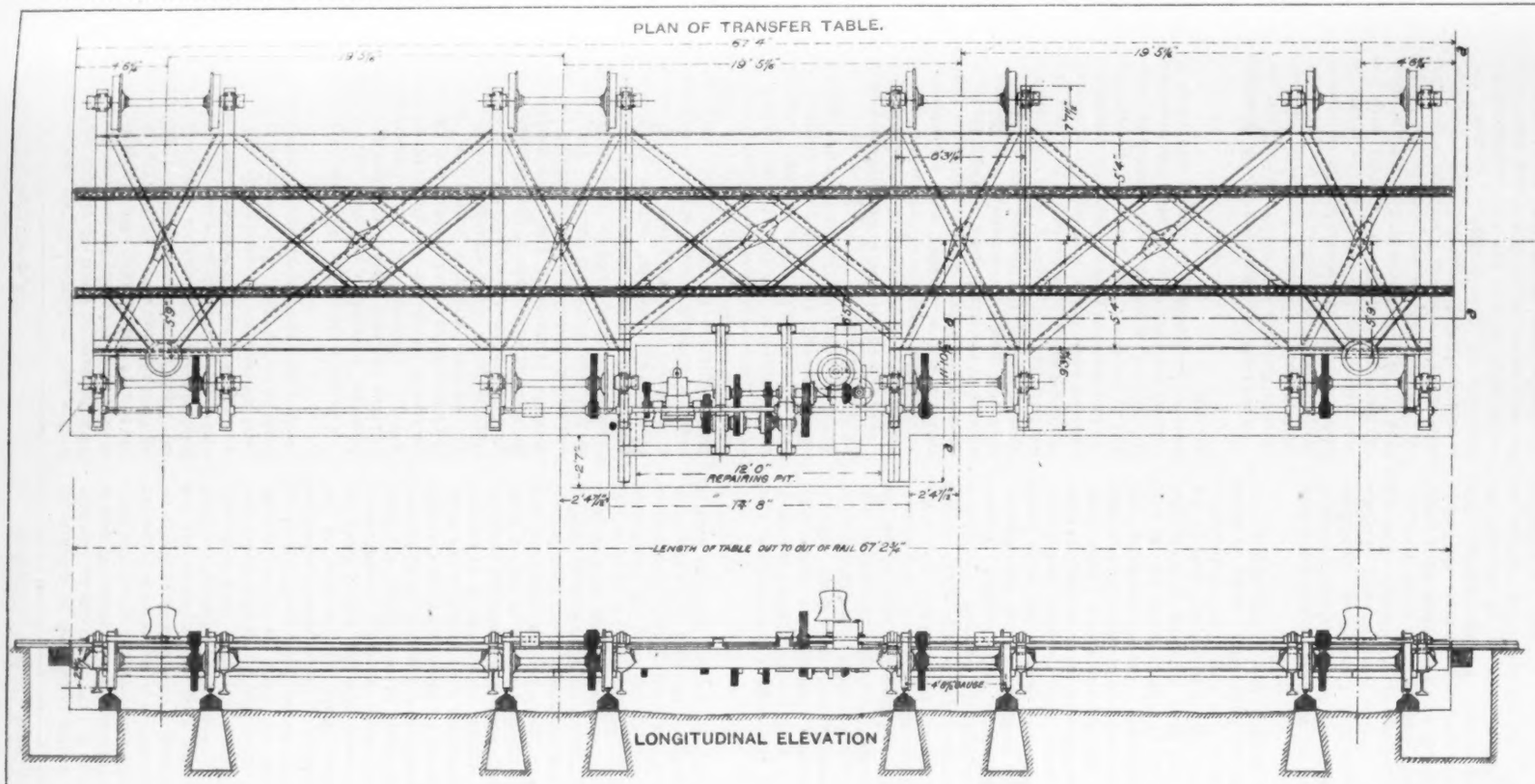
Meantime the work of the car service associations is to be warmly commended, especially in view of the intimate connection of this reform with the introduction of automatic freight brakes and couplers. If we are to go on building cars to stand on sidings and serve merely as storehouses for a good portion of the time, we can hardly afford to spend much on their running gear. If, however, a freight car made the mileage which it should make (and which it could make if automatic brakes and couplers were in universal use), we could well afford to equip it with first-class running gear throughout, to insure safe and speedy running on the road. It is plain that in this manner the one reform helps on the other.

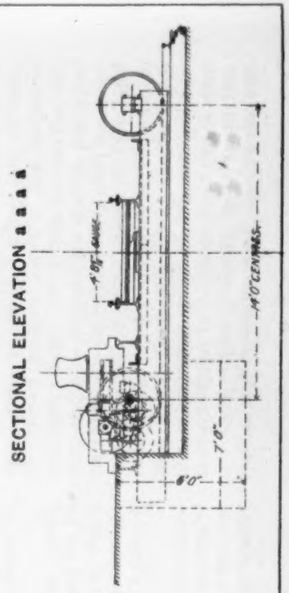
A RECENT issue of *The Engineer*, of London, contains a sensible editorial on electric lighting dangers. Our contemporary starts with a comment on the "sensational" manner in which the American press treats the late accidents and deaths from the electric current, evidently basing its general statements on some strangely garbled and woefully incorrect accounts of these accidents. But passing this phase of the discussion, *The Engineer* proceeds to give some wholesome and sound advice concerning what it regards as the real source of trouble. The fact is emphasized that until a comparatively recent period electricians dealt with electricity of moderate potential only, a pressure of a thousand volts being rather the exception and the currents almost always continuous. But within a few years the conversion system has come into favor, and the cost of cables and conduits has been enormously decreased thereby. On this system, currents of 5,000 or even 10,000 volts are sent long distances through the mains, and are then reduced by converters to the 200 volts suitable for domestic use.

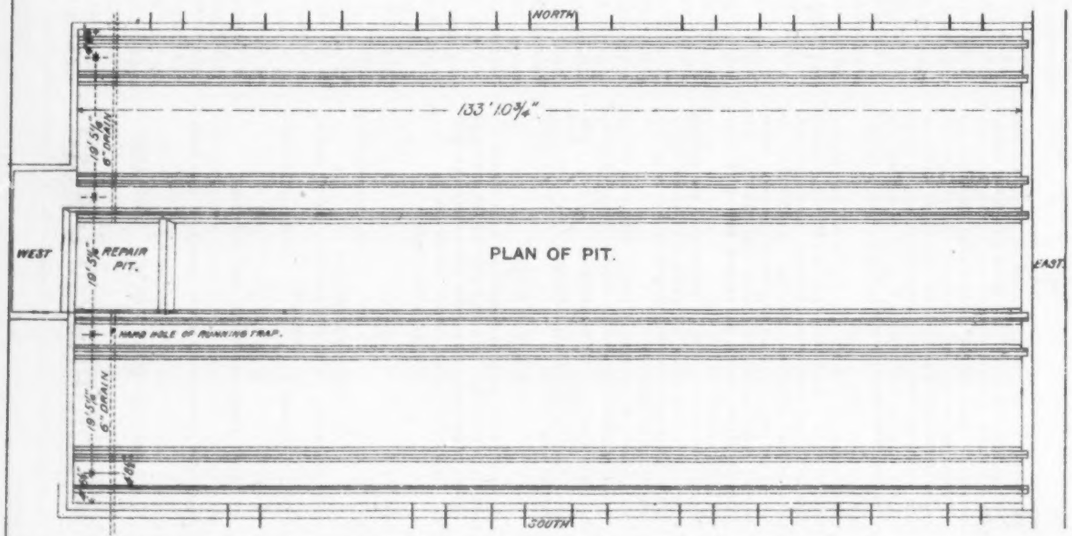
It is also shown that this conversion system enjoys favor because by it the ampères, or wire-heating elements of the current, can be reduced and a smaller and consequently cheaper cable used for transmitting a given amount of electrical energy. Currents to be converted must be alternating, and these are more dangerous to life than the old continuous current. *The Engineer* does not condemn the alternating current, nor is it in any way opposed to it; but it very sensibly points out the fact that this radical change in conditions and in the power and nature of the currents transmitted must be more carefully considered, and that some old ideas will doubtless have to be modified before its safety can be assured.

IN the light of present practice in handling electric lighting currents in New York, our contemporary touches a sore spot with no gentle hand when it refers to "the happy-go-lucky fashion" that seems to rule in some of our methods, and it is hardly too severe in characterizing our New York work as a bad case of "electrical plumbing." Just at present, we still have many poles in the street with miles of wire on them, and a so-called system of subways built and under construction—but we have no light. England and continental nations are very commonly referred to as far behind fast young America in the development of electrical science, and in many respects this is so; but this tardiness in utilizing the more powerful and dangerous currents, among our friends across the sea, may also arise from a wise caution and a due regard for the investment of capital in a great public work. A little more of this same caution displayed at the start by the authorities of this State and city in the technical and engineering study of the problem presented to them, in a change from gas to electric light, would probably have saved life, capital, and certainly much annoyance and

PLAN OF TRANSFER TABLE.







TRANSFER TABLE,

NEW YORK CENTRAL AND HUDSON RIVER RAILROAD.

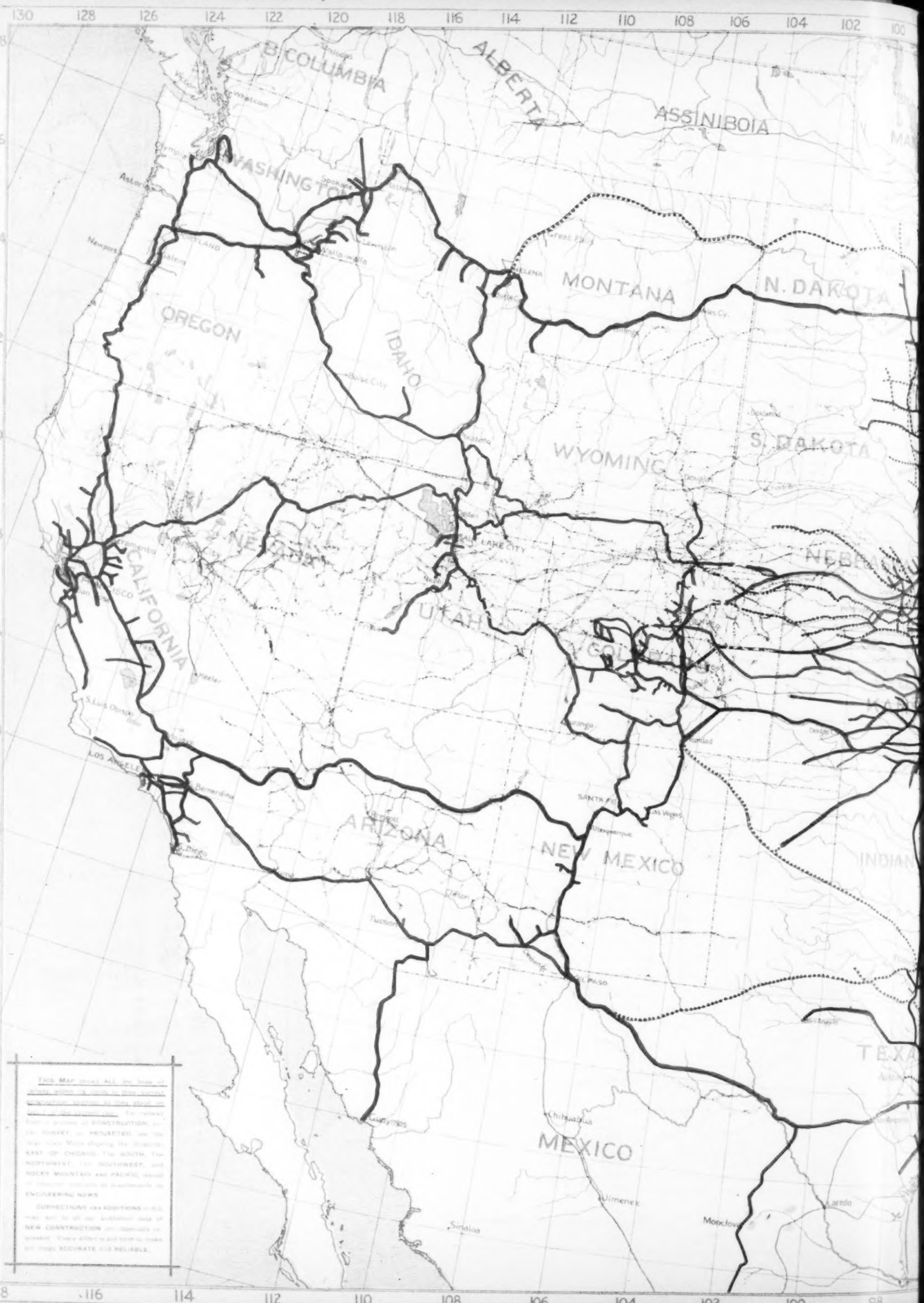
IN GRAND CENTRAL DEPOT YARD, NEW YORK CITY.

YALE AND TOWNE MANUFACTURING CO., BUILDERS.

WALTER KATTE, CHIEF ENGINEER.

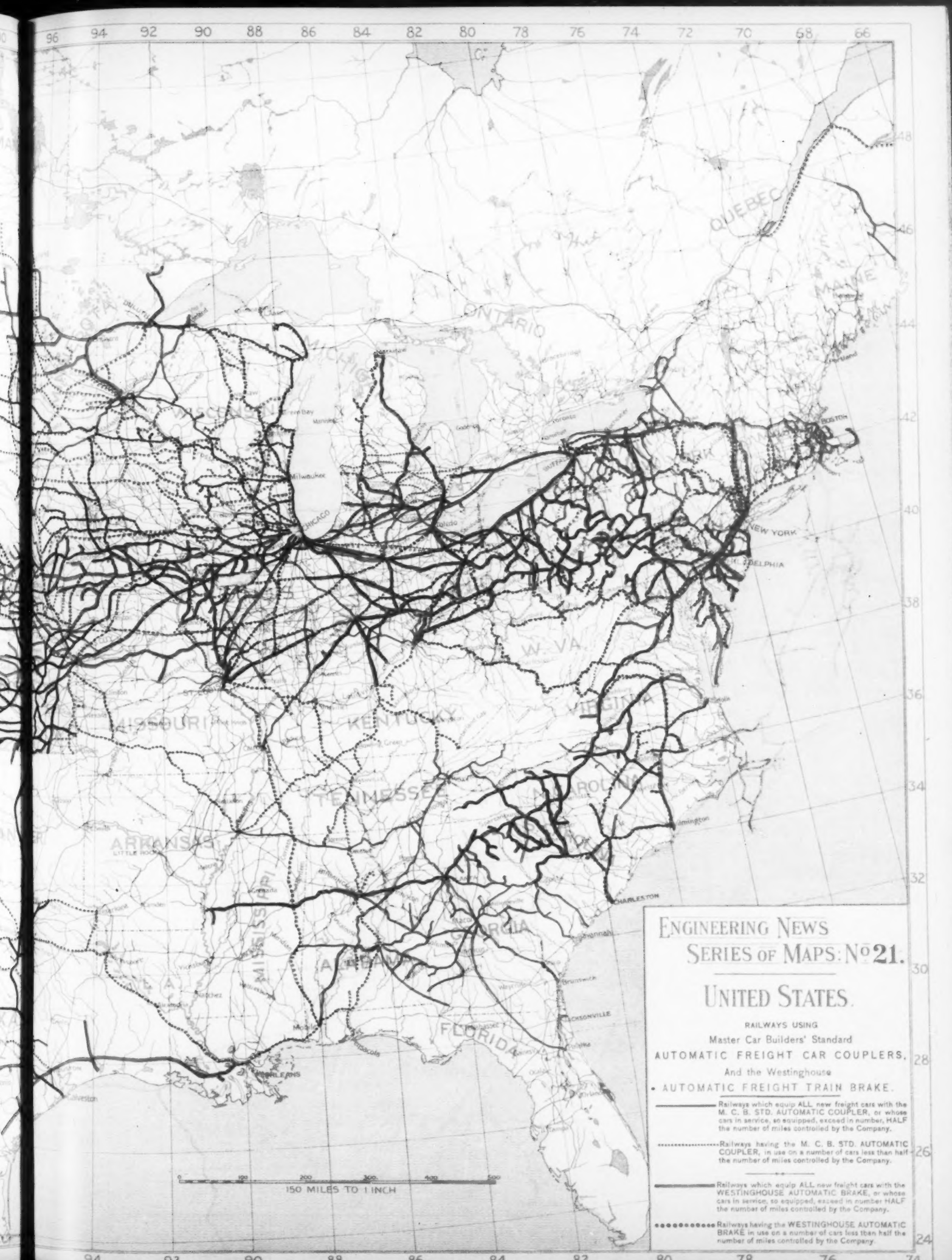
ELECTRIC MOTOR AND ATTACHMENTS FURNISHED BY SPRAGUE ELECTRIC RAILWAY AND MOTOR CO.

CHAS. HART & SONS, LITH., 38 VESEY ST., N. Y.



THIS MAP shows ALL the lines of railway which it was in their power to obtain information relative to, that should be represented. The railways that have been in process of CONSTRUCTION, and not SURVEY, or PROJECTED, on the map, cover Mexico, lying the Dominion, EAST OF CHICAGO, the SOUTH, the NORTHWEST, the SOUTHWEST, and ROCKY MOUNTAIN and PACIFIC regions of the United States, as published by the ENGINEERING NEWS.

CORRECTIONS and ADDITIONS of all kinds will be of the greatest value of NEW CONSTRUCTION, especially as opened. Every effort is put forth to make this map ACCURATE and RELIABLE.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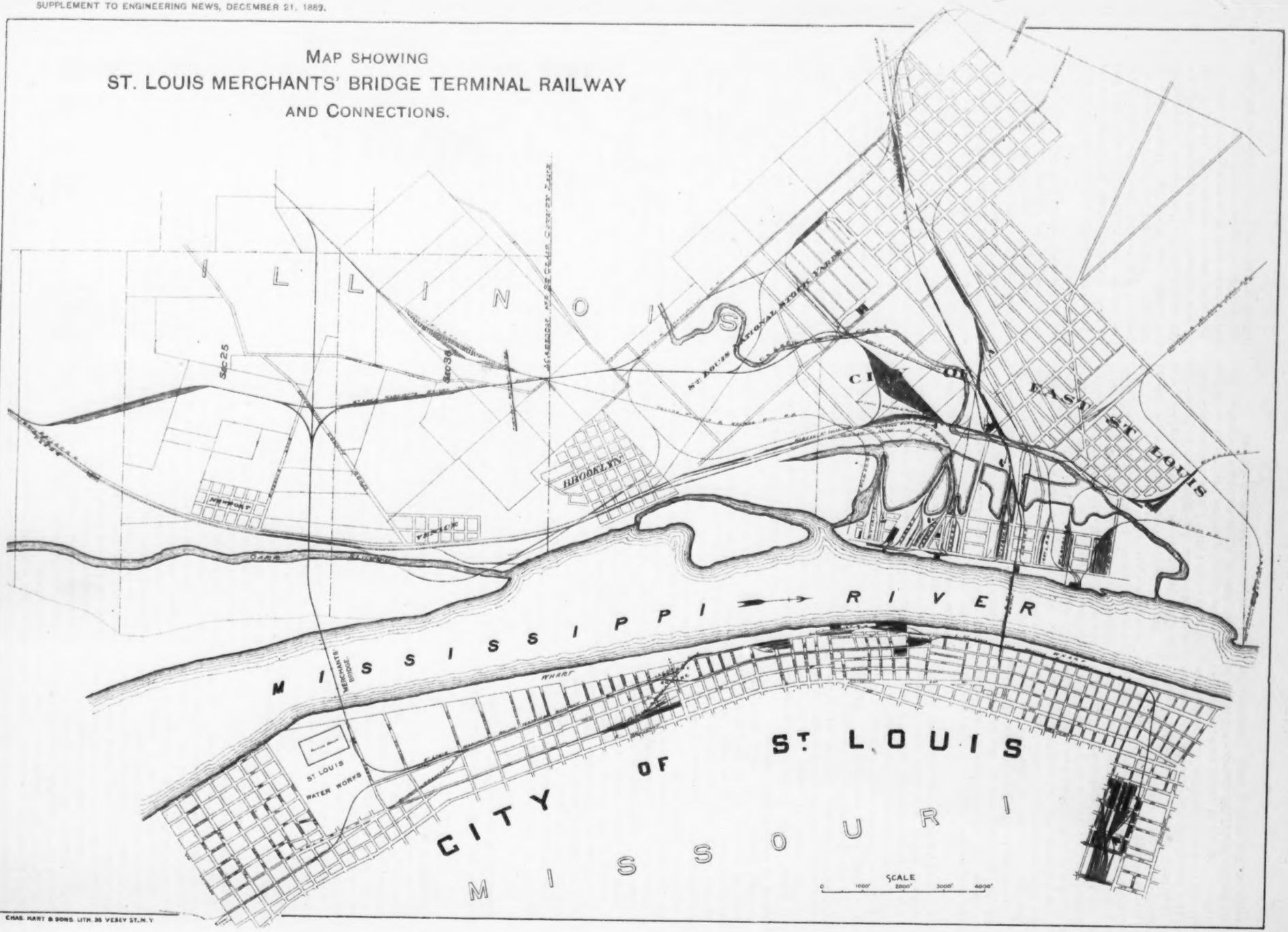
QUEBEC
ONTARIO
MAINE
MICHIGAN
Milwaukee
CHICAGO
BOSTON
NEW YORK
PHILADELPHIA
W. VA.
VIRGINIA
MISSOURI
KENTUCKY
TENNESSEE
ARKANSAS
LITTLE ROCK
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
CHARLESTON
JACKSONVILLE
NEW ORLEANS
Galveston
0 100 200 300 400 500
150 MILES TO 1 INCH
ENGINEERING NEWS
SERIES OF MAPS: No. 21.
UNITED STATES.
RAILWAYS USING
Master Car Builders' Standard
AUTOMATIC FREIGHT CAR COUPLERS,
And the Westinghouse
AUTOMATIC FREIGHT TRAIN BRAKE.
Railways which equip ALL new freight cars with the M. C. B. STD. AUTOMATIC COUPLER, or whose cars in service, so equipped, exceed in number, HALF the number of miles controlled by the Company.
Railways having the M. C. B. STD. AUTOMATIC COUPLER, in use on a number of cars less than half the number of miles controlled by the Company.
Railways which equip ALL new freight cars with the WESTINGHOUSE AUTOMATIC BRAKE, or whose cars in service, so equipped, exceed in number HALF the number of miles controlled by the Company.
Railways having the WESTINGHOUSE AUTOMATIC BRAKE in use on a number of cars less than half the number of miles controlled by the Company.

MAP SHOWING
ST. LOUIS MERCHANTS' BRIDGE TERMINAL RAILWAY
AND CONNECTIONS.



CHAS. HART & SONS, LITH. 35 VESEY ST. N. Y.

newspaper discussion of results. Poles and wires, in the quantity demanded by the uses they are put to in America, were certainly a dangerous nuisance and an eyesore in our cities. But "cheap" and inefficient subways will only open the door to further trouble and perhaps even more dangerous conditions. One life, at least, has already been sacrificed to a subway current, and the system is yet too new to have developed all its possibilities. There is work for electrical engineers to do in devising safer methods; but the community must back them up with money sufficient to reject at the start the "economical" consideration of this important subject.

Mr. BENJAMIN BAKER, in a recent lecture on the Forth Bridge, said that "the designing and building of the Forth Bridge has not been the work of one man, but of a properly officered army of 4,000 men." This, coming as it does, from an engineer whose name will be forever most prominent in connection with this great work, is a graceful recognition of the services of his many assistants,—a recognition not always accorded by the actual engineer in chief, and sufficiently rare to be deserving of notice.

Progress in the Use of Automatic Couplers and Air Brakes on Freight Cars.

There is no more important reform now pending in the railway practice of this country than the introduction of automatic couplers and air brakes upon freight cars. Viewed from the humane standpoint, the reform when complete will result in saving every year from a horrible death about two thousand trainmen, and from serious injuries, most of which cripple and disfigure the victim for life, about six thousand more of the men who handle our freight trains.

Viewed from the standpoint of economy, the reform when fully carried out promises to effect a saving of at least 10 per cent., and probably as much as 15 per cent., in the cost of carrying freight traffic, as is more fully explained in the following article.

The public is just awakening to a realization of the great slaughter that is daily going on among the freight trainmen of the country, and of the fact that the way is now open for the prevention of at least two-thirds of this killing and maiming. The recent action of the Interstate Commerce Commission on the subject, and the reference to it in the President's Message are evidences of an aroused public sentiment which seems likely to find an early expression in legislation.

Most progressive railway managers are now aware of this awakening of public sentiment; and they realize far better than the general public the fearful slaughter due to the link and pin coupler and the hand brake. The excuse—and it was long a valid one—for delaying the introduction of automatic couplers and brakes has always been, "not practicable." But a very large proportion of the railway managers of the country now understand that the Master Car Builders' Standard type of automatic coupler and the Westinghouse automatic brake are perfectly practicable for use on freight cars; and that their universal use would lessen by probably two-thirds the casualties to railway employes. A goodly number, too, realize that the reform, instead of being an added outlay purely for the employés' safety, will result in a saving in the cost of train operation far more than sufficient to pay the expense of its introduction.

The extent to which these improved appliances have already been introduced is shown in the statistics which we have collected, and which are printed elsewhere in this issue and are shown graphically on the accompanying map. In brief, there are now running over 56,000 freight cars equipped with M. C. B. automatic couplers and over 85,000 freight cars equipped with the Westinghouse automatic brake. Companies controlling 20,343 miles report to us that the M. C. B. coupler is adopted on all new freight cars; and companies controlling 19,365 miles more report the M. C. B. coupler in use on a number of cars greater than one per two miles of road (or on the average, more than one-thirteenth of the total freight cars owned). Companies controlling 14,441 miles have the M. C. B. couplers in use on a less proportionate number of cars.

The figures for automatic brakes show 31,443 miles of railway on which the brake is adopted for all new freight cars; 13,749 more miles of railway belonging to companies which have more cars equipped than one per two miles of road; and 38,109 miles having the brakes on a less proportionate number of cars.

To sum up, then, we find the automatic freight brake adopted or in extensive use on over 45,000 miles of railway, and in use to a limited degree on over 38,000 miles more, making a total of 83,300 miles.

We find the M. C. B. standard automatic coupler adopted or in extensive use on nearly 40,000 miles of road, and in use to a limited degree on 14,000 miles more, making a total of 54,000 miles.

It is to be hoped that every railway officer who examines our map and reads these figures will carefully consider their value and significance. They show: (1), that these important reforms have already made great progress. (2) That the companies which are taking the lead are the greatest of the country, whose practice in technical matters of this sort is sure to be followed eventually by minor corporations. (3) That these 85,000 cars equipped with air brakes and 56,000 equipped with M. C. B. couplers are not in use as a mere experiment. The days for experiment in this matter are past. The fact that three companies alone have 42,000 air brake cars in use, while four companies have 25,000 cars equipped with M. C. B. couplers is the best possible proof that the only question now for railway managers to consider is: How rapidly is it possible for us to equip our freight cars with these improved appliances?

But a fact of even greater importance than the number of cars equipped with these appliances is the phenomenal rapidity with which these improvements are being adopted. The reports which we have received from official sources show that the last few months have seen more progress than all previous years in the introduction of M. C. B. standard couplers.

According to the best information we can obtain, we conclude that not more than 3,000 to 8,000 cars equipped with the M. C. B. couplers were in use at the beginning of 1888. Probably the former figure is the one nearer the truth. During the year 1888 the effect of the action of the Master Car Builders' Association in settling upon a standard type of coupler became apparent, and about 15,000 cars were equipped.

But this increase was only the start toward reform; the progress of the movement was destined to a rapid acceleration. In the eleven months ending Dec. 1, 1889, a single company manufacturing couplers reports to us orders for **43,239** M. C. B. standard couplers, distributed geographically as follows:

	1888.		1889.	
	Couplers.	*Cars.*	*Couplers.*	*Cars*
Railways east of Chicago	15,800	7,945	27,072	13,536
Southern Railways	1,954	907	7,180	3,500
Northwestern "	2,078	1,039	5,763	2,881
Southwestern "	850	425	650	325
Far Western "	72	36	250	125
Private companies' cars, etc.	79	40	2,324	1,162
Totals	20,903	10,452	43,239	21,619

Another company making couplers of the M. C. B. standard type reports orders between May 4 and Dec. 1, 1889, for equipping 6,985 cars. From all the data we can gather, therefore, we estimate the progress of equipping freight cars with the M. C. B. coupler about as follows:

Cars equipped prior to 1888.	*Cars equipped during 1888.*	*Cars equipped during 1889.*
6,000	15,000	30,000

The error in the above estimates is almost certainly a too small allowance for 1889; for, while our statistics are brought up to the latest date possible, necessarily many orders in the latter part of the year were not reported to us.

The progress in the introduction of the Westinghouse freight brake has not been as rapid as that of the M. C. B. coupler, yet it has been steady. Up to the close of 1888, almost all the freight cars equipped with air brakes were on the transcontinental railways operating between the Mississippi River and the Pacific coast. On these roads, air-brake freight cars were in extensive use long before Mr. WESTINGHOUSE invented his quick-acting freight brake, which for the first time made it possible to apply the air brake to very long freight trains. These cars were found extremely profitable here, both by reason of the long and steep grades on the mountain divisions of these lines, and the high wages which have to be paid to trainmen.

A little less than 50,000 freight cars were equipped with the air brake at the close of 1887, and during 1888 and eleven months of 1889 it has been applied to about 37,000 cars more.

It is plain enough, then, that not only have the automatic freight brake and coupler come into extended use, but their general adoption is increasing at a swift rate. This is further proven by the fact that out of the great number of communications on this subject which we have received from railway mechanical officers all over the country, we do not now recall one which criticised the M. C. B. coupler or the Westinghouse brake on either theoretical or practical grounds. Moreover, we have not found thus far any road which has once put on either couplers or brakes, and has afterward taken them off.

There are still a very few roads which seem by their works to have faith that some coupler of the automatic link type is yet to win the day. But no better statement of the strong position of the M. C. B. coupler is needed than our table, which shows that there are now nearly four M. C. B. couplers in use to one of the automatic link type. Add to this the fact that two years ago the M. C. B. type was probably far behind its competitors as regards the number in use, and the fact that the automatic link type has had its day is evident.

But while from one point of view the figures we have given are most encouraging, when one realizes the waste of life and limb and property due to the use of the hand brake and the link and pin coupler, they seem all too small. Not 20,000 but 120,000 miles of railways ought by this time to be equipping all new cars with these improved appliances. One must needs wonder why there is still delay on the part of companies well able financially to inaugurate the reform.

Have the officers of any of these delinquent

companies any doubt as to the practicability of the appliances? Certainly the experience of the prominent corporations using them leaves no doubt on that score. Is there any doubt as to the crying need for these devices from the humane point of view? Certainly there cannot be, in the mind of any intelligent railway officer, to whom ocular evidence of the brutal work of hand couplers and brakes is so often presented. He knows the number of arms and hands and fingers caught between drawheads while coupling. He knows how often it happens that a blow from an overhead bridge or a fall from a train wipes out a brakeman's life.

Then why are not these devices universally adopted? Is it simply because of the cost? If this be the reason which any railway officer assigns for delinquency in pushing this reform, we would advise him to ascertain whether this expense is not like the purchase of locomotives to move a growing traffic,—one which will bring back fourfold in increased profits. This point we have endeavored to make clear in the following article.

When one considers all these things, he must conclude that if any railway officer is disposed to consult neither the safety of his employés nor the interests of his stockholders in this matter, if he neglects wholly the right of his employés to such reasonable care and proper appliances for their safety as have been proved practicable in service, if he refuses to consider the fact that the expenditures of other companies for these appliances do not yield their full fruit until all the rolling stock of the country is equipped,—if he thus wantonly infringes the rights of others, there is every prospect that he can be and will be made amenable to law for his misdemeanor.

There is much reason, indeed, to believe that the present session of Congress will result in some legislation on this matter; and if this be carefully framed, all fair-minded railway men will acqueisce in its justice. No doubt it would be better if the reform were not forced by law; but if such forcing is necessary to protect the rights of the railway companies which have already made progress in equipping their cars with these devices, there can be little opposition to its enactment.

It is pretty certain, however, that the days of opposition as well as of experiment in this matter are over. The delay in the complete introduction of automatic brakes and couplers is due more to ignorance and apathy than to actual opposition.

But even ignorance and apathy must give way before the clear and comprehensive statement of facts we present this week; and we trust that this unimpeachable testimony may have the effect of greatly accelerating this most important reform.

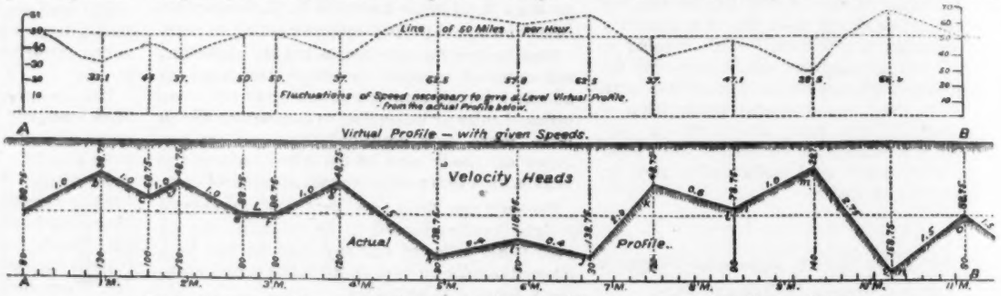


FIG. 69.—EFFECT OF VARIATIONS OF VELOCITY TO REDUCE AN UNDULATING TO A LEVEL VIRTUAL PROFILE.

[Reproduced from page 348 of the "Economic Theory of the Location of Railways," showing the conversion of a very bad actual profil into a virtual level grade, by fluctuations of velocity.]

The Money Value of Good Freight Brakes and Couplers.

It is unfortunately true that betterments demanded for humanitarian reasons alone are slow in coming into use. However clear the case, however loudly the public may demand a change, the manager of a great corporation—or of a small one either, for that matter—is slow to admit that he is bound to incur heavy expense merely to secure greater safety to employés, especially when he can claim—as in a sense he truthfully can in regard to brake and coupler casualties—that it is only "their own carelessness" which causes the suffering of most of the victims.

When there is a large element of the dramatic and the terrible about any class of casualties, as in the case of car-stove accidents, public pressure is more effective, as the remarkably rapid introduction of steam heating clearly shows; and yet it may well be questioned whether even that movement would have gone on so rapidly had it not been an easily proven fact that steam heating from the locomotive was the cheapest as well as the safest and best source of heat, once the details for using it were properly perfected. The casualties due to hand freight brakes, and still more those due to the common link and pin couplers, while appallingly frequent, come for the most part as "single spies," and the leading newspapers have long since ceased chronicling them at all, so that of excited public feeling on this subject there has been next to none. All the pressure on the humanitarian side has come from a few public-spirited men like ex Commissioner COFFIN, whose letter appears in another column, or from railway officials, engineers, and technical journalists, who have had special opportunities to become familiar with the facts.

While the pressure from this limited class has been vigorous and determined, and would undoubtedly in time have brought about reform, we may be quite certain that such notable progress as is shown graphically on the map accompanying this issue, and in figures in the editorial above,—a progress so rapid that, starting with certainly less than 6,000 cars equipped with couplers at the beginning of last year, 21,000 were so equipped at the beginning of this year, and nearly if not quite 60,000 are so at present writing,—has not been achieved for humanitarian reasons alone. These have doubtless helped to give the movement impetus, but an underlying motive must be at least a vague feeling that not only is the reform inevitable, but that it will be a paying one.

We have often before stated our belief that this will be the case, and we propose now, as perhaps the best aid that we can give to this great reform, to point out more in detail why and how it will be a paying one.

The present brakes and couplers are cheap affairs. They have been "evoluted" much as was the old plantation hoe, by making each part heavier when it broke, rather than by studying to better the conditions which caused breakages; and they are equally clumsy. A fair estimate of their average cost is given in the table in the following column.*

This, however, shows merely the deterioration in spite of repairs which are constantly going on, and which average, apart from renewals, some $36 per car per year, of which

	Cost, new.	Scrap value.	Av. life, years.	Annual Depr'n.
Brakes	$ 9.46	$2.00	6	$1.25
Couplers	29.66	6.00	8	3.83
Other parts of body.	177.86	23.00	13.2	11.67
Total body	216.18	31.00	11.1	16.75
Truck	239.94	79.00	7.5	21.50
Total, car	$456.12	$110.00	9.1	$38.25

about one-sixth, or $6 per year, is for the couplers and brakes, and about three-quarters, or $27, for truck repairs. The car may perhaps make an average yearly mileage (if it has good luck) of 15,000 miles, making the cost for repairs proper per mile run about one-fourth cent. Add to this as much more for the annual depreciation, and nearly as much more for the interest charge of $27 on the capital invested in the car, and we have only a fraction less than the long-established mileage charge of ¾ cent per mile, which is generally admitted to be an equitable sum with fair usage of cars.

Now the established price of the Westinghouse freight brake complete is $45 per car. There are about 50 cars in the United States to each freight engine, and the cost of equipping the engine complete being $450, about $9 per car is to be added to the above to cover the cost of equipping the engines, making the cost about $54 per car in all.

Similarly, the average cost of M. C. B. standard couplers is about $25 per car in place; which amounts to practically nothing on new cars, being little if any more than the cost of the old draw gear, not used. As an average of new and old cars, the cost of equipping the freight stock of a road with both automatic brakes and automatic couplers will vary but little from $66 per car.

This involves an extra interest charge of $4 per car per year, to be added to the total cost of over $100 per car for repairs, renewals, and interest charge,—surely, a trifling increase if humanity alone impelled to the improvement, when we remember that there is an admitted saving of from 50 cts. to $5 per year per car in the cost of links and pins to be balanced against this; for no one would claim that the total cost of repairs would aggregate more per year in a car so equipped than in one of the old style.

On the contrary, there will be beyond question a very large saving per annum in the cost of car repairs as soon as all or most of the stock of any road is thus equipped. The saving in this way is a mere bagatelle in comparison to those we have yet to consider; but it is worth brief attention, for no one can examine the following little table, in which the *causes* of freight car repairs are analyzed without noting that the absence of shock from slack, the perfect control given by the brake, the saving of sliding wheels, the better facilities for handling gently in yards, etc., etc., may well result in a saving of a third to a half, the former cost of car repairs and renewals, or from $24 to $36 per year per car. We do not regard even the larger estimate as at all exaggerated; nay, we feel sure that

* For details see p. 304 of the "Economic Theory of the Location of Railways," from which these figures are taken.

it will be nearly or quite realized when all freight stock is equipped; it cannot be expected to be noticeable so long as the new equipment is the rare exception. If so, this economy alone is an enormous one, covering the interest charge for the new equipment four to six times over.

DISTRIBUTION OF THE COST OF FREIGHT-CAR REPAIRS TO ITS VARIOUS CONTRIBUTING CAUSES.*

Item	Total cost of item	Distribution				
		Effect of time and age, independent of work and mileage.	Stopping and starting	Terminal: Making up trains, etc.	Curvature and grades	Running between stations on straight track
	p. c.	p. c.	p. c.	p. c.	p.c.	p. c.
Wheels	30.	.....	5.	2.	13.	10.
Axles, brasses, and boxes	30.	.....	5.	2.	5.	18.
Springs	10.	.....	2.	1.	1.	6.
Truck frame and fittings	5.	2.	1.	1.	....	1.
Brakes	5.	.....	2.	1.	2.	.....
Draw-bars	10.	.....	4.	4.	2	.....
Sills and attachments	5.	1.	2.	2.	..	.....
Car body, painting, etc	5.	3.	0.5	0.5	....	1.
Total	100.	6.0	21.5	13.5	23.0	36.0

The proportionate cost of wheels, axles, and brasses above is perhaps large, and that of brakes and draw-bars small, but it is in accordance with the best attainable information.

But this saving, whether great or small, is, as we have stated, a mere bagatelle as compared with one which locomotive engineers understand much better than most railway officers, and they in turn much better than most civil engineers, namely, the effect of the permissible range of speed upon the hauling capacity of engines over grades. It is one of the most curious facts in the history of engineering that this most important of all questions connected with the construction of railways should have been all but completely overlooked until very recently in practical treatises on the subject; and it is therefore very difficult to make the average engineer and railway man realize how vital a relation it has to the question of improved brake and couplers. We will, however, make an effort to make this entirely clear.

Every one familiar with railway operation will on reflection recall a striking fact, that whereas there are enormous differences in the average lengths of freight trains hauled on various lines, because of differences in grades, there is only a trifling difference in the maximum passenger train hauled. A heavy train on a long dead level, like the Hudson River Railroad, is 10 to 12 passenger cars. Precisely the same train will be handled in case of necessity over ragged and ugly profiles, like that shown on the preceding page, † if the maximum rate be not much over 1 per cent., and a fair working train for such a profile will be 8 or 9 cars, whereas a freight train handled over the same grades at ordinary freight speeds will not be more than a third to a quarter as long as can be hauled over the Hudson River Railroad.

The reason for this notable contrast lies simply in this,—that when weak hand-brakes and "ramshackley" coupling-gear forbid raising the speed of freight trains over 15 miles per hour in the bottom of a sag, the train has only energy enough stored in it to lift it 3.55 ft. vertically, which does not go far toward helping it to climb the next hill whereas, if the speed may at such a point be 40 miles per hour, it can lift itself 56.80 ft. vertically, without aid from the engine; and if 50 miles per hour, 88.75 ft. Consequently, the engine has little to do in hauling a fast train out of a sag. The energy stored in it in the form of extra velocity, when descending into the sag, expends itself usefully in lifting the train out of it, so that at a speed of 50 miles per hour, even so ragged and bad a profile as is shown in the accompanying cut becomes a "virtual" level, and is operated as such at passenger speeds. How this is done is sufficiently indicated by the cut, the upper part of which shows by ordinates the fluctuations of velocity, with the speed in miles per hour corresponding to the "velocity-head" necessary to correct the actual profile into the absolutely level virtual profile shown just above it.

Now if we had not both good brakes and good couplers on a passenger train, it is perfectly obvious that it would not be possible to operate such a piece of road in this manner. Even with them, it will never be possible so to operate freight trains, for the reason that freight trains must always be loaded so as to be barely able to crawl over the tops of the heaviest grades, if their load is adapted to the full capacity of the engine. But the only thing that can be done with the coming freight train will be to allow its speed to fluctuate greatly, so that, after crawling to the top of a long hill, it will run down again at as high a speed as the grade, and perhaps the engine too, can give it, instead of wasting energy by brakes. This high speed will enable it to "float" over the next grade with but little aid from the engine, as well as to make much better time.

As the nominal railway profile may be said to be undulating, this method will enable every freight train to "take a run" at almost every grade, except a few long mountain grades, operated by pushers, and so will reduce its "virtual" rate to perhaps half or a quarter of the profile rate. A 1 per cent. grade two miles long, for example, rises 105.6 ft. The energy in a train striking the foot of it at 40 miles per hour, as just given, takes off half this lift at once, and yet enough of the stored velocity remains to leave the train moving at 15 miles per hour at the top of the hill. The "virtual" grade, therefore, is at once reduced one-half; and if the train strikes the foot of the hill at 50 miles per hour, reduces the virtual grade in the same way from 1.0 per cent. to 0.15 per cent., or almost to a level.

Whether a freight train can actually have this velocity at the foot of such a grade depends wholly on the grades back of it. The engine cannot give it, for it is supposed to be too heavily loaded; but on the ordinary undulating profile of four-fifths of the railway mileage of this country, a sharp upgrade generally means a sharp down-grade or a level for a few miles back, on which the train can readily acquire a high speed if it is only made safe for it to do so.

A few roads—of which the Lake Shore & Michigan Southern is a prominent example—are already using this principle of fluctuating velocity in the hauling of far heavier trains, even double the number of cars that they hauled a few years ago with the same engines. Under existing conditions it is only those roads which have least real need of this advantage, those having fairly favorable and easy grades already, which can safely do it with old-style freight cars, because with other roads the danger of breakaways and other casualties is too great. But it cannot be too often or too forcibly insisted on, that, with good train brakes and non-breakable close couplers, and with the slight betterment of springs and running gear which is sure to come with them, it will be not only possible but proper to let freight trains run up to the highest passenger speeds on down grades and levels, and do their crawling only on the upper parts of the heavier up-grades.

Two enormous economies will immediately result from these conditions. The first and most important of these will be a marked increase in the average length of freight trains. We are desirous of estimating this increase conservatively, yet we are conscious that even the most cautious estimate will seem exaggerated to those familiar only with the handling of freight at present freight speeds, and not accustomed to think of high speeds as an aid to hauling greater loads. But we believe it to be a most conservative estimate that at the very least this increase of train load will average 20 per cent. throughout the United States, and on very many roads or divisions will be over 50 per cent.; it being assumed, of course, that certain changes are made in the position of stations and stopping places on or near the foot of grades, so as to take full advantage of the new conditions, which the pressure of competition and of example would be quite sure to cause at an early date.

Now, an increase of 20 per cent. in train load means a saving of about 10 per cent. in the total cost of transportation, which is about equal to the entire cost of repairs and renewals of cars, or some $72 per car per year, the total earnings of each car having been last year about $635 and the total freight operating expenses about 68.7 per cent. of this, or $436. Large as this saving is, when freight trains can if they wish run 60 miles per hour, or can where they must drop down to 10 miles per hour, it will certainly be realized; and after all, it will be a small matter compared with the vast and steady progress in economy which has brought down freight rates so remarkably in the last twenty years.

Another great economy will be an increase in the average yearly mileage of cars and a decrease in the interruption to traffic resulting from the widely different speeds of freight and passenger trains. If a speed no higher than the present is assumed on long up-grades, and all the speed the engine can give allowed on favoring grades, there will result, first, a very great increase in average speed, and secondly, very much less wear and tear of brakes, running gear, and car body, due to the fact that freight engines, like passenger engines, will be exerting a nearly uniform pull on the drawbar all the time, up hill and down; and so, although the speed will vary, it will vary uniformly and almost insensibly, by the gentle action of gravity.

We will not attempt to estimate this saving, beyond a bare chronicle of the fact that, whereas sleeping cars make from 100,000 to 150,000 miles per year, and ordinary passenger cars 40,000 to 60,000, the average freight car makes only from 10,000 to 15,000, and the favored class of "line" cars only 25,000 to 35,000. In part the difference is a necessary one. The passenger cars have regular daily duty. The freight cars have intermittent work and long terminal delays; but the sharpness of the contrast is due directly and indirectly to the lower speed of freight trains. Now, the interest charge alone on an average freight car is $27 per year, and getting double duty out of it means saving half of this, or $13.50 per year, not considering the fact that double mileage does not mean double cost for repairs and renewals, by any means.

We are conscious of having considered this

*Reprinted from page 243 of Economic Theory of Location of Railways: Table 86.

†This cut, which appears on page 348 of the "Economic Theory of the Location of Railways," is a somewhat exaggerated reproduction of the actual profile of thousands of miles of railway in this country.

great question on a low plane throughout this article. It seemed best to so consider it. But the decisive argument ought to be the humane one. Most of the collisions, most of the breakaways, practically all of the falls from moving trains, deaths by overhead bridges, and injuries from exposure, as well as nearly all of the frightful aggregate of coupling casualties, can be saved by a moderate further investment of $4 per year per car, or say a $4,000,000 charge on the present United States freight earnings of $640,000,000. Is not this little enough? Are we not all willing to pay one-half of 1 per cent. higher freight rate to save many hundreds of lives and thousands of limbs per year? To ask the question, surely, is to answer it. A careful estimate made some years ago (1885) by the writer of this article showed 459 killed, 4,080 severely injured, and 13,770 slightly injured, or **18,309** accidents per year in all, caused by couplers alone; this being less than half of the total casualties which might be abated by good brakes and couplers together.

When so frightful an aggregate of misery as these figures represent can be saved by an investment so sure to be also immensely profitable financially, the end cannot be doubtful or far off. The Interstate Commerce Commission has already done much to hasten it. It can, and we have faith to think it will, do much more; but our map shows that, even without outside pressure, the movement is acquiring an impetus which in a few years more will complete the reform—the greatest in the history of railroading.

The Merchants' Bridge across the Mississippi River at St. Louis.

We give considerable space this week to the map and plans of the Merchants' Bridge at St. Louis, which, in view of its interesting engineering features and the effect which its construction is likely to have on the railway traffic of St. Louis and its tributary territory, is doubtless the most important bridge now being built in the United States.

At present all access to St. Louis from the east is had by the bridge built by the late Captain EADS, or by boat transfer across the Mississippi River. In July, 1881, this bridge was leased to the Missouri, Pacific & Wabash, St. Louis & Pacific Railway Companies at an annual rental consisting of interest on bonds, semi-annual dividends of 6 per cent. on first preferred stock, and of 3 per cent. on second preferred stock. The lessees also pay all taxes, assessments, etc., and are to pay the bonds when they fall due in 1928.

The company's report for 1888, as published in "Poor's Manual," shows the following figures:

Tons freight moved		3,143,183
Passengers carried		1,475,204
Freight cars moved		368,429
Passenger, baggage, etc., cars moved		140,114
Total cars moved		508,543
Gross earnings		$1,703,300
Operating expenses		847,513
Net earnings		$855,787
Fixed charges:		
Interest on $5,000,000 bonds at 7 %	$350,000	
Dividends on $2,400,000 1st pref. stock at 12 %	288,800	
Dividends on $3,000,000 2d pref. stock at 6 %	180,000	
Taxes, etc.	23,888	
Total fixed charges and rentals		852,688
Surplus		$3,099

It will be seen from the above that the fixed charges of the present St. Louis Bridge Co. are sufficient to pay interest at 5 per cent. on over $17,000,000.

The charges for transferring cars across the present bridge are for loaded freight cars $4.46 per car, which is considered very exorbitant; and this has operated to greatly handicap the growth of St. Louis. Fully 60 per cent. of the present traffic across the bridge is said to be local business originating in or consigned to St. Louis. Through traffic is largely diverted to bridges farther north over the Mississippi. The heavy transfer charges on the bridge have also diverted a considerable amount of traffic to ferries and boat transfers. During the fiscal year ending April 30, 1889, 72,000 loaded freight cars were tranferred by the Wiggins Ferry Co.

About two years ago prominent business men of St. Louis, realizing the disadvantages their city was under by reason of the monopoly held by the existing St. Louis Bridge Co., organized the St. Louis Merchants' Bridge Co. to build a competing bridge across the Mississippi, with a complete system of terminals on both sides of the river. It was also believed that, with the opportunities now existing to secure capital at a low rate of interest, and with the great economies effected in bridge construction since the EADS bridge was built, the new bridge could be constructed at a cost so moderate that it could make a handsome profit in transferring passengers and cars at rates one-half those charged by the present bridge company.

The movement for a competing bridge met with much approval from the citizens of St. Louis, and very liberal ordinances were passed by the city council, granting to the company the right to use the streets of the city for a double track railway and the right to build an elevated structure on the levee, as well as the right to cross the streets.

The Merchants' Bridge is located about two and one half miles above the old bridge. Its location may be more definitely seen by reference to the inset map in this issue. The details of its construction are given in preceding pages.

On the east side of the river the company has purchased a large tract of land for use for terminals by the various railroads, and has prepared to accommodate, without crowding, a very large business. On the east approach north of the bridge there is a connection with the Wabash, the Cleveland, Cincinnati, Chicago & St. Louis, and the Chicago & Alton Railroads; on the east with the Toledo, St. Louis & Kansas City Railway; and on the south with the Venice & Carondelet Belt Railway and the East St. Louis & Carondelet Railway, through which belt railroads connection is made with the Vandalia, the Ohio & Mississippi, Louisville & Nashville, and all the other railways which reach East St. Louis. On the west the Merchants' Bridge Terminal Company has a right to build north as far as the Chain of Rocks, where the city is now building new water-works; also to build west to reach railroads in the rear of the city, and south along Hall St. and Main St. to the levee, passing under the arches of the old bridge and along the levee for nearly a mile on a double-track structure, and thence west, below Poplar St., to a connection with the St. Louis & San Francisco Railroad tracks, and the tracks at the union depot.

The Merchants' Bridge Terminal Company will operate the bridge with its own motive power, taking freight and passenger trains across the river from the terminal of each road on each side of the river and placing the cars in railway or depot yards or at the private sidings of principal manufacturers and merchants as may be desired.

It is an essential feature of the project to build a handsome and commodious union passenger station in a place where the travelling public will be better accommodated than in the present inconveniently located union depot. This, with the reduced charges for the transfer of cars and passengers entering or leaving the city from or to the east, is expected to greatly stimulate the growth and prosperity of St. Louis, and to secure a large increase of traffic to the railways which enter the city, both from the east and the west.

CORRESPONDENCE.

Wanted,—Broken Stone.

Dec. 14, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

I see in the columns of ENGINEERING NEWS that the people of Union County, New Jersey, are improving their roads with a coating of trap-rock. I want the address of parties who have broken stone to sell. As one of the directors of a Turnpike Company I am acquainted with the proprietor of the quarry at Bergen Hill near Jersey City on the Pennsylvania Railroad; he has control, apparently, of all the trap rock that comes into this part of the country and we have to pay accordingly for it. Hence if you can give me the desired information, I will be very much obliged.

* * *

[Parties who have broken stone to sell in quantity can send their address to this office, and we will forward them to our correspondent without delay. Better still, place a permanent advertisement in our columns, where it will be read by thousands of interested parties, like our correspondent, who is a Pennsylvania farmer, but yet sees a chance to save some money by using the superior facilities of ENGINEERING NEWS.—ED. ENG. NEWS.]

The Prevention of Conflagrations.

BROOKLYN, N. Y., Dec. 16, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

To the many who are taking note, with much concern, of the heedless methods of erecting buildings as regards security against fire, it gives a feeling of relief that ENGINEERING NEWS, a journal so widely circulated among brainy readers, has taken an earnest stand in the matter of improvement in the construction of buildings and the abandonment of the short-sighted policy of looking at the immediate cost and income rather than to build securely, with slower but far greater returns.

As every fire, covered by insurance or not, is directly or indirectly a loss to every active man or woman within the reach of civilization, and as every fire has to be paid for by the insured, meaning almost every person doing business, be it ever so small, the subject should arouse a general determination to bring about a radical change in the structure of buildings, the ways and means for which are so clearly and encouragingly pointed out in your issues of Dec. 7 and 14.

With reference to these directions, attention is drawn to two important points: The first is, the want of prominence given to the greatest sources of destruction to buildings, to wit, elevator shafts and open stairways, which cause fully 80 per cent. if not 90 per cent. of all the losses, and of life particularly, due to fires starting in the buildings destroyed. All manner of otherwise fireproof construction will avail but little when incorporated with such huge "chimneys," converting the building into a furnace, with every floor on fire in a few minutes. It seems therefore that means for avoiding this great source of danger and destruction, without too much inconvenience, should be the first step towards security, all else being secondary in comparison. The recent decision of the Supreme Court, regarding unprotected electric wires, lays down the broad rule, that all practically avoidable danger to life must be abated summarily. The loss of life through fires, spread beyond control by stairways and elevator shafts, exceeds that caused by electric wires. Let the mandate of this high court, fully applicable to this subject, be carried out first; and then see to the lesser causes of insecurity.

The second point refers to the use of automatic means for extinguishing fires in their incipiency, without reliance upon immediate human agency or action. About 2,000,000 automatic sprinklers are said to be in use with most satisfactory results. Mention is also made of the difficulties and drawbacks accompanying their application. One of the greatest objections to their use is the damage generally done by the water, and their liability to freezing.

As a cheap and safe substitute, the following has been long proposed. Let carbonic acid gas and other "fire-extinguishers" be suspended near the ceiling, so arranged that an excess of heat, say at 110° Fahr., will set them into action, through the expansion of air, or of a fluid of low boiling point and latent heat. Such an apparatus constitutes a vigilant watchman, ever on the alert, requiring but a yearly inspection

and perhaps renewal of part of its contents. Their cost is small, and the safety thus secured promises to be great.

It is well known, and was fully discussed in the Brooklyn *Daily Times* some years ago, by ex-fireman SCHOLES, a prominent, public spirited citizen of Brooklyn, E. D., and by others, that such gases put out fires, such as of rosin, oil, sugar, and similar substances, upon which water has little or no effect. It is also well known that the damage done by water is frequently greater than that done by fire: also that water thrown upon an intense fire in insufficient quantities feeds the fire by its decomposition, particularly when carbon predominates in the burning substances, instead of putting it out; as prominently shown in sugar-house and similar fires.

With a passably enclosed room, and but the flimsiest partitions between it and adjoining rooms, a fire should make no headway after such an apparatus is set into action. It first sets off the alarm, and immediately the process of putting out the fire is commenced, whether the alarm is heeded or not, being thus entirely independent of human vigilance, attention, or neglect. Such an apparatus is simple and promises to be reliable at all times. For instance, with a non-inflammable liquid, having a boiling point under 110° Fahr. and a latent heat less than one fourth that of water, spread in a film over a thin plate of copper having a stiff abutment downwardly,—the heat of the fire gases rising to the ceiling would be transmitted to the [illegible]. Such an enclosed thin film while securing ample force to set the apparatus into operation infallibly, is prevented from rupturing its containing vessel by the expansibility of its upper side, acting against the glass to be broken or whatever the arrangement may be.

Such an apparatus promises to be in action in a small fraction of the time it would require to warm and fuse a solder, however low its melting point, perhaps not under 150° Fahr.

These fire-extinguishing gases being heavier than air, have a tendency to first spread over the floor, and then gradually to fill the whole space, an outlet being provided for the lighter gases to escape. As such an apparatus is inexpensive, a number of them might be used, at the rate of about one to every 400 sq. ft. of floor space.

By far the most frequent and the most destructive fires occur in the winter, a time when sprinklers may be frozen, and the streets blocked with snow. On the other hand, these fire-extinguishing gases are available in all seasons.

A solid brick building, without iron front, etc., with enclosed elevator-shaft and stairway, provided with sheet-iron cased wooden shutters (perhaps asbestos lined), covered with suitable hollow tile-roofing, etc. and guarded by such automatic fire-extinguishers, should be proof against fire from without or within and at a moderate advance in cost of construction.

Respectfully,

ROBERT CREUZBAUR.

[The leading suggestions of this letter seem to us sound; but there are probably difficulties, not apparent on the surface, which have prevented their more general acceptance.—ED. ENG. NEWS.]

Power vs. "Continuous" Brakes.

TO THE EDITOR OF ENGINEERING NEWS:

Since the delivery of the President's Message, there has been a manifest determination to give practical effect to that part of it relating to brakes and couplers. I understand that a movement is already under way to obtain such legislation as will enforce their adoption upon railroads. While believing that some such action is necessary, in the interests of the roads themselves, as well as for the protection of the employés and the public, there is a most decided objection to the power of Congress being exercised for the benefit of any single corporation. This would be the case if legislation were made to include the terms used in the discussion of this subject in magazine articles and most of the technical journals.

By the introduction of the term "continuous brakes," there is a limit set to the choice of brakes by the railway companies, and any competitor who may produce an "independent brake" is thereby shut out, although he may have a superior and cheaper power brake. This contingency does not rest upon mere supposition, for the writer declares it to be a fact that an independent brake system already exists that is simpler, safer, and far cheaper than any continuous system ever can be.

There are upward of 1,000,000 freight cars in use in the United States. To equip these with brakes such as are now in use would require an expenditure of $30,000,000. Practically there is but one "continuous brake" in general use, and that is the Westinghouse air brake; and excellent as this brake is when in good order, it is so exacting in its requirements, so delicate in its construction, and consequently so liable to get out of order, that to render it safe requires at all times the attention of a trained staff of pneumatic engineers. It is therefore not only the first cost of such a brake that needs consideration, for the price of its utility is the eternal vigilance of skilled labor. Its adoption for all trains places the management of roads in the hands of their skilled employés, who are thereby enabled to dictate their own wages. It will thus be seen that the railroads themselves have a considerable interest in the solution of this problem, not the least of which is the finding of the necessary means of purchase and operation. To some this necessity may present no difficulty, while to others it may be almost insuperable. It may, therefore, be well to consider if there be not some other way of meeting the requirements of the case, and one that will not call for so large an expenditure of capital, while at the same time providing for the safety of the employés and the efficient working of the traffic.

A case in point: There is a railroad running through the State of New York whose traffic and grades compel the use of engines of the highest capacity, and these engines are fitted with a locomotive brake, a simple and cheap but efficient device. The testimony of the road in regard to it is, that by its use an engineer can handle any train that his engine can haul. In freight service it is relied upon altogether for making stops, no brakeman being called out. This brake has double the power of the engine's wheel-adhesion, and is fitted with a valve that prevents wheel-skidding, so that the engineer can stop any train that he can haul, upon any grade, by the use of his engine brake alone. Such a brake is eminently suitable for roads of limited means, as it meets the requirements of the President's message, in that it provides for the safety of the train men. In order to show more clearly that it does so, consider the special dangers that train men are exposed to upon trains having no power brake. Such dangers arise solely from the necessity of going over the tops of the cars to apply the hand brakes. Here they are exposed to contact with overhead obstructions; cold benumbs and wind upsets them; snow and ice on the roofs of the cars render their foothold insecure; sudden lurches jerk them off; a broken brake-chain hurles them under the wheels. By rendering it unnecessary to go on the top of the cars, all dangers that are special to train-hands on moving trains are wiped out; and this great life-saving function is fully accomplished by the engine-brake alluded to. Hence, legislation should be so framed that any road that desired to use such a brake could do so, and in doing so should be regarded as having complied with the law.

Under any circumstances, it would be manifestly unjust to limit congressional action to any such term as "continuous" brakes. Railways should be left free to choose the best form of power brake, and if "independent brakes" are produced that are better than "continuous brakes," such superior brakes should not be barred out by act of Congress. Yours truly,

JAS. HOWARD,
General Manager Beals Brake Co.

[It is a real difficulty of the present brake situation that any action in accord with the general view of the requirements of the case may tend to create a monopoly. Had our correspondent added to his claim for the independent brake system of being "simpler, safer, and far cheaper," the simple words "*and more effective*" or "as effective," we should have regarded his case as absolutely unanswerable, and should have been heartily with him in his demand for a fair field and no favor. But as we understand the facts and our correspondent's claim, it is that his brake is a capital thing for ordinary working, and a vast improvement on the hand brake, but that *in emergencies* it is "not there" in the sense of being able to make a quick stop. We are therefore constrained to say that this is not the solution of the brake question which the situation demands nor one which the law ought even to permit, much less to encourage. What the situation demands, and what must and will be soon enforced by law, as well as by the calm good sense of competent railway officials, is a freight train brake equal to *all* emergencies and *all* demands or as nearly so as the state of the arts permits. Half-way measures will not do. They should not be, and they will not be, permitted. Humanity as well as true economy forbids.—ED. ENG. NEWS.]

NOTE.—In our last week's issue, in Mr. LESCHORN'S letter on the Howe Truss, the word "areas," in the fifth line from top, should read *ares*. Mr. LESCHORN'S name was unfortunately "pied" in some of the impressions so as to read "Lenchors."

Notes and Queries.

J. W. W., of St. Louis, Mo., asks for the "best" multiplication table for bridge computations. This is rather a broad question; but "Buchanan's Tables of Squares" will meet his want, in part at least. These tables give the *squares* of every foot, inch, and sixteenth of an inch, between one-sixteenth of an inch and fifty feet. If other tables of wider range are in use among bridge computers, our correspondent would doubtless be glad to hear from them.

Brick Street Pavements.

At the late meeting of manufacturers of brick, at Philadelphia, Mr. J. H. CALKINS, of Galesburgh, Ill., read a paper on "Paving Brick; Its Manufacture and Use." The following is a brief abstract of the paper and the discussion which followed it:

MR. CALKINS said, in selecting clay don't mix "hard" with it, nor take clay mingled with soft or fire clay. Use a clay that when burned hard will melt together like iron, or vitrify, in other words. Then water will not penetrate it, and it will even resist a steel drill. This clay should be thoroughly pulverized, and made into a stiff mixture by water. The bricks should be made on a machine with an "under pressure." Put all the clay into the brick possible, and dry and burn as with other brick, but burn them hard.

In paving a street, grade to a proper profile, and have under it a hard, well-drained foundation; spread 4 ins. of sand evenly over the foundation, and put the bottom bricks flat and lengthwise with the street and roll with a hand roller: spread one inch of sand on this first layer, and then set the top brick on edge across the street; roll with a heavy roller, and put on one inch of sand and brush it well in the joints. Pavements so laid will last, under ordinary traffic, one hundred years, as they have done in Holland.

Mr. J. W. BILLINGSLY, editor of *Drainage Journal*, published in Indianapolis, did not believe that the clays were as scarce as Mr. CALKINS supposed, but thought that the proper clay could be found in most localities. At New Cumberland, W. Va., good pavers are made. At Lincoln, Neb., 20,000,000 bricks have been put in the streets. At Des Moines, Ia., several miles have been laid. At Decatur, Ill., good pavers are made, and 6½ miles of street have been paved. At Bloomington, Ill., the first brick pavement was laid fourteen years ago, and is still good. These bricks are not extra hard. He said the quality of clay in Indianapolis was all right. Bloomington now has about 6½ miles. Des Moines, Ia., has about the same as Lincoln, 20,000,000 bricks.

Mr. D. V. PURINGTON, of Chicago, Ill., said that one great advantage of paving brick was that it makes a smooth road, and the wheels move over it with very little noise. He said he believed that fire clay, instead of being a detriment, was a benefit in making paving bricks. He said that Philadelphia clay would make too flinty a brick. He believed that there was as much chance for development in paving brick as in any other branch of the business.

Mr. W. A. EUDALY said that bricks should not be burnt to vitrification, as that made them glassy and brittle; but he also agreed that all kinds of clay would not make good pavers. One thing, he said, was certain,—that the clay that would not stand a high degree of temperature, and that would not vitrify, would not make a good paving brick. He said that the common size of paving bricks was the most practical, because these bricks, when not sufficiently burned in the kiln, could be used for common brick purposes, and thus prevent a waste in that direction: and this size also insured, in a measure, bricks that were hard enough for the purpose. One point which he made was of considerable importance: he said that in Cincinnati some very hard granite was put down for paving purposes, the city engineer having discarded the softer granites. After a time the granite became glossy and the horses fell upon it, causing a petition against it to be circulated by the citizens. The result was that the pavements were taken up, and the soft granite, which had previously been discarded, was put in its place with improved results. This goes to show that any paving material which is liable to be polished in the course of time is unsafe for paving purposes, and this a brick would not be. He hoped that the brick paving contractors would not cause brick paving to be condemned by putting in cheap brick.

Mr. DRUMMOND, of St. Louis, Mo., thought that any kind of clay could be so manufactured as to make good pavers; but Mr. ETTENER, of the same

city, emphatically denied that it was possible to make paving bricks out of St. Louis clay.

Mr. T. S. MILLER, of New York, raised the question of a brick polishing, by use in a pavement. He brought up this same question in Memphis the year before, and thought there was considerable doubt as to whether or not a paving brick which would be hard enough for the purpose, and would exclude the water, would not polish in use the same as a granite block. He hoped that the polishing would be proved impossible, for he believed that a paving brick that would polish by use would be as useless for paving as granite. Several gentlemen, including Mr. PURINGTON, emphatically denied that the right sort of brick for paving purposes would polish.

THE CHICAGO DRAINAGE COMMISSION just elected is made up of the following members, the name of the ticket being added: MURRAY NELSON (Citizen); RICHARD PRENDERGAST (Citizen); HENRY J. WILLING (Citizen); CHRISTOPHER HOTZ (Citizen); ARNOLD P. GILMORE (Citizen); JOHN J. ALTPETER, (Citizen); JOHN A. KING (Democrat); W. H. RUSSELL (Democrat); FRANK WENTAR (Democrat). There are some excellent men on this list, and the board is on the whole satisfactory. This is a substantial triumph for the Citizens' ticket.

Automatic Freight Brakes and Couplers from a Humanitarian Point of View.*

The purpose of the following article is to call the attention of the readers of ENGINEERING NEWS to the humane side of the automatic brake and coupler reform, and to enlist their influence in favor of some well-considered national legislation that will aid in checking the fearful slaughter and maiming of the faithful men who handle freight trains. The most powerful argument in favor of this much-needed reform is simply a statement of actual facts.

Taking the issues of the *Railway Age* from Nov. 1, 1889, to Nov. 29 inclusive, we find by the record in that journal under the head of "casualties" the following: that during the thirty-four days from Oct. 19 to Nov. 23, there were 37 trainmen killed outright and 20 seriously injured—losing an arm or a leg, and in several instances both legs—while engaged in duties which would not be required if automatic brakes and couplers were in use. Of these 57 deaths and injuries, 23 were due to the use of the old hand-brake and 34 occurred while their victims were coupling cars. It is the judgment of the writer, from several years of observation, that the above number, large as it is, does not cover half the cases of death and serious injury occurring during the period named from the above two causes.

The official report of the Iowa State Railroad Commission for 1888 shows that in that State alone there were, during 1888, a total of 352 killed or maimed from these two causes alone. This would give a monthly average of over half as many killed and injured on railways in the one State of Iowa as the *Railway Age* reports for all the railways of the United States. It is to be remembered that we are considering only two causes of accident. In the same period of time—from Oct. 19, 1889, to Nov. 23—there were killed and injured in other railway accidents, according to the *Railway Age*, 133 employés. These latter injuries and deaths come from accidents which in the present stage of railway practice seem to be unavoidable, such as collisions, derailments, broken bridges, broken rails, wheels or axles, misplaced switches, etc.—unavoidable, I say, until a higher standard of competency and accuracy is attained, both in the materials and methods of railway operation.

But has not the time come when this terrible record of tragic deaths and fearful sufferings from crushed limbs, incurred in going between cars to couple and uncouple them, and in going upon the tops of cars to handle the brakes, should no longer disgrace railway practice in this land of enlightened Christian humanity? For remember that if the ratio of accidents to miles of railroad is the same throughout the United States that it is in Iowa, there are not less than 6,000 able bodied men killed and injured yearly in the United States by these two causes alone. Even suppose the number of casualties in the whole United States to be only half this (a supposition which we know from statistics to be almost impossible) who can comprehend, even then, the enormous amount of suffering caused?

Take the briefer period first named. Here in one short month 57 strong young men are either carried to their homes as mangled and almost unrecognizable corpses, or with bodies so mutilated that it would seem it had been a blessing to them to have been killed outright. And this is probably much less than half the actual number of the sufferers. Do we, who are enjoying the wonderful blessings due to our modern railway facilities, realize how great a price these brave boys of the rail pay for the benefit we reap?

Should we not show our appreciation of these deplorable facts by demanding through an outspoken public sentiment, crystallized into law, if need be, that if there are practicable appliances of reasonable cost which will give these men greater safety, the owners of railway property should be required to use them?

That there are automatic couplers and that there are power brakes, as practically applicable to freight as to passenger car service, no practical railway man will now deny. That if these were put into use, a very large proportion, at least 75 per cent., of this terrible maiming and killing of these young men could be prevented, cannot and will not now be disputed.

It is now proven that automatic couplers and power brakes are as practically applicable to freight as to passenger cars, and would prove to be an actual saving in operating a railroad. For, without considering the delays, expenses, and damages arising from continual wrecks, the sum of money paid out annually by the railroads to partially alleviate the suffering of these injured men and their families is greater than the cost of the safety appliances.

While on the railroad commission, the writer spent months on experimental trains with the ablest railroad experts, for the purpose of ascertaining the practicability of using the automatic couplers and brakes on freight cars, and, as said above, every doubt on this matter was removed, and was so admitted by the railroad experts who, as a committee from the National Master Car Builders' Association, had these experimental tests in charge; and they so reported to that body. But no matter how humane the general officers and management may be, or how willing to put on these life and limb saving appliances, they are often powerless to do so except as the boards of directors vote to appriate the money for this special purpose.

The "absenteeism" in the ownership of our railway property prevents the owners from realizing the dangers to life and limb to which those engaged in the railroad service are continually exposed.

All who are familiar with the temper of most boards of railroad directors are aware that the great demand from them upon the managers of their property is for "dividends." They are very slow to listen to anything from these managing officers that calls for a considerable present outlay of funds. These presidents and general managers should be reinforced when they go before the boards by a "public sentiment" or a "thus saith the law."

Many of the companies, including most of the leading ones, are now rapidly pushing the work of equipping their cars with these safety appliances; but in order that they should derive the greatest benefit from their use, all connecting roads which send cars over their line should take similar action. In justice to the progressive and humanely managed corporations which have adopted these appliances, in justice to the faithful trainmen whose wages barely compensate them for their arduous labor and allow nothing for the peril in which they place their lives and limbs, the managers of railways which have not yet adopted these devices should do so at once. And if neither these weighty reasons nor their own self-interest are sufficient to induce them to act, justice demands that this infraction of the rights of their employés and of other common carriers, should be made a misdemeanor by the laws of the nation.

*Written for ENGINEERING NEWS by Hon. L. S. COFFIN, Ex-State Railroad Commissioner of Iowa.

The Dunderberg Gravity Railroad.

The railroad shown on the accompanying map was evidently not laid out in the manner in which the Czar of Russia located the railway from St. Petersburg to Moscow; nor is it presented as a sample of the art of locating railways with minimum curvature as practised in the United States.

It belongs to a class of railways of which very few examples exist, but which are destined to become more and more common, whose purpose is merely to carry pleasure travel, and to do it without the more or less disagreeable adjuncts which are inseparable from the use of a locomotive.

Dunderberg Mountain is located in the Hudson Highlands, in Rockland County, N. Y., about forty miles from New York City. The projected railway shown on the map will start from a point on the West Shore Railroad near the river level, and will ascend the mountain by an inclined plane, worked by cables, having a grade of 29 per cent. to an altitude of 1,100 ft. From the summit of this plane the gravity road runs by a circuitous route, as shown, all around the flanks and foothills of the mountain, and finally returns to its starting point. The total length traversed is about fifteen miles, so located as to give passengers the best opportunity of enjoying the wild scenery of this region.

Map of Proposed Gravity Railway on Dunderberg Mountain in the Hudson Highlands.

The total cost of the railroad and all equipment is estimated at $500,000. It is believed by the projectors that the proximity of New York and Brooklyn and other large cities will insure the road a very profitable traffic. The popular route for excursions will doubtless be by steamer up the Hudson from New York City, giving pleasure seekers a two hours' sail through the Hudson Highlands in addition to their thirteen-mile trip by rail on the mountain.

The enterprise is projected by Messrs. T. L. and H. J. MUMFORD, who have managed for some years the Mauch Chunk, Summit Hill & Switch Back Gravity Railway at Mauch Chunk, Pa. The line has been located, and is expected to be put under contract early in the coming year.

From an engineering point of view, the enterprise is a highly interesting one, and seems perfectly feas-

ible in every way. A well-kept gravity road, by virtue of its easy riding and freedom from noise, smoke, and dust, is peculiarly suited for pleasure excursions. A road on a similar plan to the above, but on a smaller scale, has been built the past season near Reading, Pa.; and a short one with moderate grade has been proposed in Philadelphia for Fairmount Park.

Transfer Table, New York Central & Hudson River Railroad.

(With Inset.)

The inset sheet accompanying this issue shows the latest example of a new type of electric transfer table, which has proved very effective and satisfactory. The previous tables of the same type have been erected at Altoona, Pa., for the Pennsylvania Railroad, at Aurora, Ill., for the C. B. & Q. R.R., at Waukesha, Wis., for the Wisconsin Central; and at Reading, Pa., for the Philadelphia & Reading.

The table illustrated differs from the earlier ones chiefly in the electric gear, which is of 15 H. P. instead of 7½ H.P., and also has a different contact arrangement. In this table the contact is obtained from a couple of heavy copper wires stretched taut about 3 ft. apart over the second of the four parallel tracks, the wires being carried on insulators fixed to light cast-iron cross-beams, so as to be a few inches above the rails. The conductors are kept taut under all changes of temperature by springs at their further end. Over these wires two concave contact rollers travel beneath the table, being kept in contact by gravity only. In the Altoona table there is an under contact maintained by springs, the conductors being carried in a wooden channel, while at Waukesha an overhead trolley system is used. The gravity system seems the more natural and least liable to disturbance, as the conductors are held so far above the track that they are little liable to disturbance from snow or other chance interference. The current used is only 220 volts, and hence, while not wholly pleasant to take in one's body, it is in no way dangerous. The current is taken from the same dynamo that furnishes light for the station. The full current capacity of the table motor is 60 amperes.

The motive power is supplied by a Sprague electric motor of 15 H. P., as stated, the speed of which is governed by a switch which throws the winding of the field into different electric combinations, thus altering the current, maintaining a practically constant strength of field without the use of any wasteful resistance. The control over the speed of the motor is perfect, and no complicated nest of gearing for changing speed is required.

The motor is supported at one end by double compression springs playing upon a bolt which rests upon the platform of the transfer table, according to the regular Sprague method, which has been developed in street railway work and other places where it is desirable to start slowly under a heavy load. At the other end the motor is sleeved on to a rigid support. By means of this flexible attachment, danger of stripping the gears is eliminated, and the strain upon the gear is always a progressive one. The reduction in speed of the motor of the transfer table is effected by two reductions with direct gearing.

The advantages of electric power for this work are claimed to be great. The equipment is very much lighter than if steam power were used, and there is no expense of operation when the table is not in use. One man can easily handle the table, and more conveniently and directly than with steam.

The two end capstans shown on the table are fixed; the center one is revolved, in either direction, and either fast or slow, by a simple clutch gear. It is used, of course, for working cars onto or off the table without locomotive power.

The capacity of the table is 100,000 lbs. Ordinary car axles, bearings, and wheels are used throughout for the running gear, and the total cost of the table and motor complete was under $7,000. Its speed is about 150 ft. per minute, the same as the old wire rope table which it replaces. The old pit was lengthened somewhat, and is now 67 ft. 2½ ins. long, accommodating ten tracks, as shown in plan. The rails are carried on wooden longitudinals resting on small masonry foundation walls. The pit drains directly into the city sewers.

The table is constructed with 15-in. cross beams and 12-in. longitudinals, thoroughly braced with a rigid iron lateral system as shown. It was designed and built by the Yale & Towne Manufacturing Co., of Stamford, Conn., the electric gear being designed and furnished by the Sprague Electric Railway & Motor Co., of New York City. The table operates very easily and satisfactorily. A small cabin, not shown, is provided for the man operating.

A Manual of Railway Field Work and Laying Out of Works.

ACCORDING TO THE MOST RECENT AND APPROVED PRACTICE ON AMERICAN RAILWAYS.

BY A. M. WELLINGTON,
M.Am.Soc.C.E., M.Inst.C.E., etc.

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[The author will be pleased to receive typographical or other corrections, or suggestions as to form or substance, from any interested reader. All such suggestions will have full consideration.]

CHAPTER II. THEORETICAL PRELIMINARIES.

[*Continued from p. 572.*]

TO LAY OFF A RIGHT ANGLE FROM ANY LINE, given two points AB ft. apart, Fig. 32.

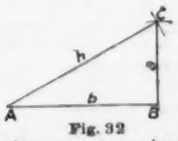
Fig. 32

First Method.—We have by geometry $a^2 + b^2 = h^2$ whence $a = \sqrt{h^2 - b^2}$ ( ) b being usually some even value, we may assign a likewise some even value, and hence readily compute the value of h by the aid of Table 33 of squares. Usually, however, one of the following methods is preferred.

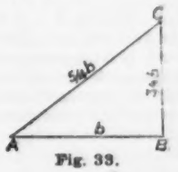
Fig. 33.

Second Method.—Any triangle having sides to each other as 3, 4, and 5 is a right-angled triangle, since $3^2 + 4^2 = 5^2$. Therefore, TO LAY OUT A 3, 4 AND 5 TRIANGLE from any base b, we have (1) Fig. 33, $AC = \frac{4}{3}b$ and $CB = \frac{5}{3}b$, whence $AC + CB = 2b$; or

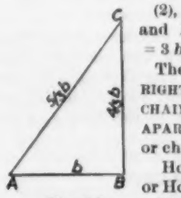
Fig. 34

(2), Fig. 34, we have $AC = \frac{5}{4}b$ and $BC = \frac{1}{4}b$, whence $AC + CB = 3b$.

Then we have, TO LAY OUT A RIGHT ANGLE WITH A TAPE OR CHAIN, FROM TWO POINTS b FT. APART, holding one end of the tape or chain (the zero end) at B.

Hold at $2b$ (on A) and $\frac{5}{4}b$ (on C), or Hold at $3b$ (on A) and $\frac{1}{4}b$ (on C).

If the tape be not long enough to include $AC + BC$ in one measurement, the sides to construct the 3, 4 and 5 triangle must be laid off separately.

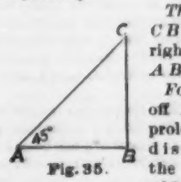
Fig. 35.

Third Method.—Fig. 35. Lay off $CB = AB$; then, if ABC be a right angle, $AC = \sqrt{2}\,AB = 1.414\,AB$.

Fourth Method.—Fig. 36. Lay off $BD = AB$ on the line AB prolonged. Then will any equal distances $AC = CD$ construct the isosceles triangle ACD, which CB will bisect into two right-angled triangles.

Fig. 36.

Fifth Method.—From any point O, Fig. 37, with radius OB, describe a semicircle ABC. Fix the point A where the arc intersects the line AB, and prolong the line OA to cut the arc in C. Then will CB be perpendicular to AB; for the angle ABC is inscribed within a semicircle.

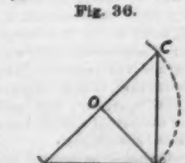
Fig. 37.

The last method is convenient from the simplicity of the measurements, and from the fact that no computations whatever are necessary. All five are occasionally useful.

A NORMAL to any curve at any point is a line perpendicular to the tangent at that point. In circular curves, since the radius passing through any point is likewise perpendicular to the tangent at that point, a normal is merely the radius prolonged.

TO LAY OFF A NORMAL OR RADIAL LINE AT ANY POINT OF A D° CURVE, P, Fig. 38.

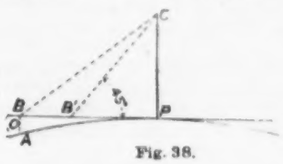
Fig. 38.

From any other point A on the curve, distant n stations from P, lay off the offset $BA = O = \frac{1}{8}n^2 D$ (Eq.). Then will the line BP be tangent to the curve at P. From B (or any other more convenient intermediate point B') lay off the right angle BPC by any of the methods above given. Then will the line CP be the radius prolonged, or a normal to the curve.

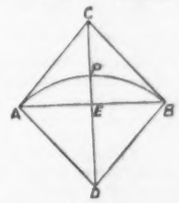
Fig. 39.

Second Method. — Determine any points on the curve, A and B, Fig. 39, making $PA = PB$. With any distance $AC = CB$, construct the isosceles triangle ACB fixing the point C. Then will CP prolonged bisect the chord AB in C and be perpendicular thereto, and consequently it will be a radial line. A similar point D may be fixed in the same manner on the other side of the curve, and will lie in CP prolonged.

This method is much used in taking out trestles on curves.

THE FOLLOWING APPROXIMATE FORMULA is an extremely useful one for a multitude of practical uses, for most of which it is amply exact. It should, therefore, be engraven on the memory, ready for use at any time.

TO SOLVE A RIGHT-ANGLED TRIANGLE OF SMALL ALTITUDE, given the altitude a, Fig. 40, and either base b or hypothenuse h.

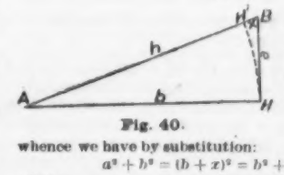
Fig. 40.

$$\text{Formula: } h - b = \left.\begin{aligned}&\frac{a^2}{2b}\\ &\frac{a^2}{2h}\end{aligned}\right\} \text{nearly} \qquad (\ )$$

Demonstration. — Strike the arc HH' and let the distance $H'B = x$ = excess of length of h over b. Then we have $a^2 + b^2 = h^2$ but $h = b + x$, whence we have by substitution:

$$a^2 + b^2 = (b + x)^2 = b^2 + 2bx + x^2$$

whence $$a^2 = 2bx + x^2$$

and $$x = \frac{a^2}{2b + x} \qquad (\ )$$

But as x is by hypothesis very small in comparison with $2b$, it may be dropped from the denominator of the fraction, and we then have

$$x = \frac{a^2}{2b} \text{ nearly.} \qquad (\ )$$

Similarly, we have, to determine x in terms of a and h:

$$h^2 - b^2 = a^2.$$

But $b = h - x$,

whence $$h^2 - (h^2 - 2hx + x^2) = a^2$$

and $$x = \frac{a^2}{2h - x}$$

Dropping $-x$ from the denominator as before, as relatively very small, we have

$$x = \frac{a^2}{2h} \text{ nearly} \qquad (\ )$$

In the form of a rule, we have:

TO SOLVE A TRIANGLE OF SMALL ALTITUDE, GIVEN THE HEIGHT AND EITHER SIDE: *Square the altitude and divide by twice the base or hypothenuse. The quotient will be the difference between hypothenuse and base* nearly.

The degree of approximation can be judged from the fact that it is tolerably approximate even for the extreme case of the 3, 4 and 5 triangle, which is not a triangle of small altitude. We have by Eq. ( ) $D = \frac{3^2}{2 \times 4} = \frac{9}{8}$, giving for the hypothenuse 5⅛ instead of 5; or, by Eq. ( ) $D = \frac{3^2}{2 \times 5} = \frac{9}{10}$

giving for the base 3.9 instead of 4, in each case an error of one-fortieth part. For a triangle of base 100 altitude 10, we have $D = \frac{10^2}{200} = 0.5$, giving for the hypothenuse 100.5, the true value being $h = \sqrt{10^2 + 10^2} = 100.498756$, or within $\frac{1}{1000}$ part. For altitude 20 we have $D = \frac{400}{200} = 2.0$, giving for the hypothenuse 102.0, the true value being 101.9804.

Chaining on regular slopes can often be done more accurately by determining the correction due to the slope by this formula than by attempting to step down the slope (§) with the chain held horizontally.

By extension of this useful formula we have:

TO DETERMINE THE INCREASED LENGTH IN A LINE AB, FIG. 41, DUE TO A LATERAL SWERVE IN THE MIDDLE OF THE LINE. We have:

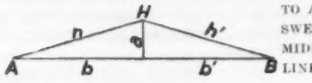

Fig. 41.

$$h - b = \frac{a^2}{2b},$$

Letting $b + b' = A\,B = L$, and L' = the total distance $A\,H\,B$, remembering that the above equation expresses only half the total error, we have:

$$L' - L = \frac{2a^2}{L} \qquad ( )$$

Examples.—1. $A\,B = 20$ miles, $a = 3$ miles. Then the loss of distance by such a lateral deviation, shown by scale in Fig. 41, is $\frac{2 \times 3^2}{20} = 0.9$ miles, nearly. It is actually 0.881 miles if the offset is exactly in the middle.

2. The middle of a chain is deflected 2 ft. outward by an obstruction. Error resulting, $\frac{4 \times 2}{100} = 0.08$ ft., which may be allowed for.

While Eq. ( ) is demonstrated only for the case when A bisects $A\,B$, it applies with sufficient exactitude for most cases when A is well within the middle third of the total distance. In other cases the loss must be computed for each side of H independently.

It will be apparent from Eq. ( ) that the maintenance of exact alignment is of small importance in chaining compared with care in the actual measurements. When measurement only is the end in view, the chain may be lined in by eye with ample exactitude, even for very accurate work.

TO DETERMINE THE DIFFERENCE IN LENGTH OF A FLAT ARC AND A CHORD.

Let $A\,D\,C\,E\,B$, Fig. 42, be a circular arc and $A\,B = b$, its chord. Draw the two sub-chords $A\,C$, $C\,B$, and also the secondary equal sub-chords $A\,D$, $D\,C$. Then, if $a =$ the middle ordinate, we have by § .... $a' = \frac{1}{2}a$, $a'' = \frac{1}{2}a' = \frac{1}{4}a$, and so we may go on subdividing the arc indefinitely. Furthermore, the sub-chord $A\,C = \frac{1}{2}b$ *nearly*, and $A\,D = \frac{1}{4}b$ *nearly*. Then for the difference in length of the chord $A\,B$ and the two sub-chords AC, CB, we have by Eq. ( ):

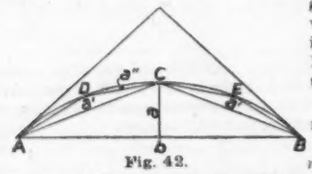

Fig. 42.

$$\frac{2a^2}{b}$$

For the difference in length of the two chords $A\,C$, $C\,B$, and the four sub-chords $A\,D$, $D\,C$, $C\,E$, $E\,B$, we have similarly

$$2 \times \frac{2a'^2}{\frac{1}{2}b} = \frac{8a'^2}{b} = \frac{a^2}{2b}$$

For the difference in length of the four chords $A\,D$, $D\,C$, $C\,E$, $E\,B$, and a tertiary system of eight chords, we have similarly

$$4 \times \frac{2a''^2}{\frac{1}{4}b} = \frac{32a''^2}{b} = \frac{32\left(\frac{a}{16}\right)^2}{b} = \frac{a^2}{8b} \text{ etc.}$$

These several differences constitute a series of the form

$$\frac{2a^2}{b}\left[1 + \frac{1}{4} + \frac{1}{16} + \frac{1}{64} + \text{etc.}\right]$$

Summing this series by Eq. ( ) we have as the value of the bracketed term $1\frac{1}{3}$, whence we have

$$\text{arc} - \text{chord} = 1\tfrac{1}{3}\frac{2a^2}{b} = \frac{8a^2}{3b}$$

But $a = 0.218\,n^2\,D$ (Eq.) and $b = 100\,n$ *nearly*, whence we have, letting d = arc — chord

$$d = \frac{1}{800}\,n^3\,D^2 \text{ nearly} \qquad ( )$$

Examples.—1. Arc 300 ft. long of 10° curve;

$$d = \frac{1}{800} \times 3^3 \times 10^2 = \frac{2700}{800} = 3.375$$

whence long chord is given as 296.625. True value by Table 14, 296.61.

2. Arc 1,000 ft. long of 1° curve $d = \frac{10^3\,1^2}{800} = 1.25$, whence long chord = 998.75; true value, 998.744.

This formula is remarkably accurate for one so simple in form, being precisely correct by Table 14 even for such extreme cases as 6 stations of 10° curve (Long-Chord 573.0) or 10 stations of 6° curve (Long-Chord 955.0). Beyond 60° of central angle it rapidly falls off in accuracy, as shown in the following table, which also illustrates the degree of accuracy in the formula, the first line giving the true long chord by Table 14 and the line below the correction given by the formula. The two together, obviously, should aggregate even hundred feet if the formula be precise. The errors are somewhat lawless in distribution, but always so small that they may be neglected in practical field-work.

D	2 sta.	4 sta.	6 sta.	8 sta.	10 sta.
2°	199.97	399.70	598.95	797.45	995.00
	.04	.32	1.08	2.56	5.00
5°	199.76	398.00	593.22	783.90	968.64
	.25	2.00	6.75	16.00	31.25
10°	199.00	391.95	573.00	736.64	878.89
	1.00	8.00	27.00	64.00	125.00

EXTENT AND DIRECTION OF ERROR.

2°	+0.01	+0.02	+0.03	+0.01	Right
5°	+0.01	Right	−0.03	−0.10	−0.11
10°	Right	+0.05	Right	+0.64	+3.89

This formula may advantageously be memorized, which is easily done by analogy with

Formula .... $O = \frac{7}{8}\,n^2\,D$

and Long-Chord Correction Formula $d\,\frac{1}{0.0}\,5 = n^3\,D^2$ using one higher power of the two variables n and D, while the co-efficients $\frac{7}{8}$ and $\frac{1}{800}$ have enough in common to greatly aid the memory. With the formula memorized, long chords can be determined readily without a field-book at any time; but a field-book being generally at hand, it is much less important to memorize this formula than the others which have already been recommended for memorizing.

A TOPEKA, KAN., BRICK PAVING CONTRACT has been cancelled by Judge GUTHRIE on the ground that two members of the City Council are interested in the company formed to execute the contract. There is no objection to the brick as a paving material.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Chicago & West Michigan.—Thirty-three miles of the 75-mile extension from Baldwin to Traverse City Mich., have been completed and grading is in progress on the remaining distance. It is expected that the grading will be practically completed this month and the road will be ready for traffic by May 1. Work is being pushed on the Manistee River bridge. Surveys are in progress for a further extension north from Traverse City.

Kennebec Central.—FREDERIC DANFORTH writes us that this road is to run from Randolph via Chelsea to Togus, Me., a distance of 5 miles. The stock has been all subscribed by the citizens of Randolph and Gardiner. The grading is to be completed by Jan. 1. About 100 men are now at work on the line. FREDERIC DANFORTH, of Gardiner, Me., Chief Engineer, is in charge of construction.

Delaware, Lackawanna & Western.—An agreement has been entered into between this company and the Lackawanna & Montrose R. R. Co., incorporated last summer, by which the building of the latter road is assured. The new road is to run from Montrose, N. Y., to Alford Station on the D., L. & W. R. R. The terms of the agreement are as follows: The new company will procure the right of way and grade the roadbed. The D. L. & W. will build the superstructure, taking in payment therefor stock of the new company, and will operate the road on the basis of the actual cost of running a like number of miles on the main track.

Lake Shore & Michigan Southern.—The annual report of this company for the last fiscal year shows the following results from operations.

Gross earnings	$18,672,484
Operating expenses	11,634,471
Net earnings	7,038,013

Tobique Valley.—About 14 miles of this road has been graded and tracklaying commenced Dec. 2. It is expected to have 10 miles of the line completed by Jan. 1. C. L. B. MILES, of Andover, N. B., is Chief Engineer.

Mahoning Coal.—Notice has been published calling a meeting of the stockholders of this company to be held at Cleveland on January 8, to consider an increase in the capital stock of $400,000 preferred stock, to be used in purchasing the Mahoning & Shenango Valley Railroad, the Shenango Valley Railroad, the Stewart Railroad, and the small Lake Shore branches extending from Doughton Station to Sharpsville and Sharon. When these branches are purchased they will be leased to the Lake Shore & Michigan Southern Co.

Boston & Maine. At a meeting of the stockholders held recently, it was voted to increase the number of directors from eight to eleven, and JAS. FURBER, of Somersworth, N. H., ALVA SULLOWAY, of Franklin, N. H., and ASA A. PATTU, of Boston, Mass., were elected to fill the positions. By a unanimous vote the directors were authorized to issue stock, common or preferred, to an amount not exceeding $3,500,000, the same or the proceeds of the same to be used to retire by exchange, purchase or otherwise the company's outstanding 7 per cent. bonds. A special meeting followed, when the lease of the Northern (N. H.) Railroad was approved by a vote of 42,095 shares to 142.

Projects and Surveys.

Sandusky, Columbus, Lake Erie & Southern.—This company has completed its profiles and estimates for the cost of construction of its proposed line from Sandusky to Columbus, Ohio. The surveys have been completed and it is stated that construction will commence early in the spring. CHAS. A. JUDSON, of Sandusky, is chief engineer.

Amherstburg, Lake Shore & Blenheim.—This company has called for tenders for the construction of its line from Colchester to Amherstburg, at one end, and through Harwich to Blenheim, at the other end. The road is projected to run from Amherstburg to Blenheim, 60 miles. Mr. PARDO, Reeve of Raleigh, Ont., is President. JOHN A. AULD, of Amherstburg, is Secretary.

Walhonding Valley.—Incorporated in Ohio to build a line of railway from Kimbolton to Mansfield, O., a distance of about 65 miles. Among the incorporators are: A. J. WARNER, WM. R. POMERENE, HENRY C. HERRIG, and JOHN C. FISHER.

Baltimore Belt.—This company is having considerable difficulty in securing the right of way for its proposed tunnel and belt railway at Baltimore, Md. The object of the company is to construct a tunnel under Howard St. beginning at a point near the Camden St. Station of the Baltimore & Ohio R. R. and running north about 2 miles to Jones' Falls. This stream will be crossed by bridges and connection will be made with the Maryland Central R. R. whose tracks will be used to the Union Depot. From this point the line will skirt the northern part of the city and join the main line of the Baltimore & Ohio R. R. at a point about 5 miles distant. The total length of the line will be about 7½ miles. The tunnel will be 27 ft. wide and is estimated to cost about $5,000,000.

SOUTHERN.—Existing Roads.

Memphis & Raleigh.—E. SCOTT, of 258 Second St., Memphis, Tenn., sends us the following information concerning this enterprise:

The road is to run from Memphis to Raleigh, Tenn., a distance of 11 miles. The business of the road will be principally in suburban travel. The contracts for construction will be let Dec. 25, and work will be commenced Jan. 1. It is expected to begin tracklaying sometime in February, and have the road completed and in operation by April 1. The road will be standard gauge, and laid with 56-lb. steel rails. JNO. FARGASON, of Memphis, is President.

Roanoke & Southern.—An election will be held in Roanoke, Va., Jan. 28, to vote upon the proposition to subscribe an additional $100,000 to the stock of this company.

Alabama Midland.—Tracklaying on this road has been completed nearly to Troy, Ala.

Montgomery Belt.—The contract for constructing the extension from Whitman St. to Commerce St., Montgomery, Ala., has been let to Thos. Joseph, of Montgomery, and work is now in progress.

Louisville & Nashville.—Engineers are reported in the field making surveys for the change in the route of this road between Louisville and Lexington, Ky., 94 miles. The line between Frankfort and Pleasureville and between Yarnallton and Deckers Station will be straightened and other improvements will be made.

Knoxville Southern.—An official of this road is quoted as saying that tracklaying would commence soon and that the road would be completed to the Georgia State line by July 1, 1890.

Georgia, Carolina & Northern.—An official of this road is reported as saying that the grading is completed from Chester, S. C., west 50 miles, and that work is rapidly progressing.

Chipley & St. Andrews Bay.—Construction is re-

ported in progress on a railway to run from Chipley, Fla., to St. Andrews Bay. The road is being built on the old roadbed which was partly graded and abandoned some years ago. Maj. B. F. HOLLAND, of Chipley, is at the head of the enterprise.

Projects and Surveys.

French Broad Valley.—This company will be ready to receive proposals for grading on the division from Asheville, N. C., to Wilson's, 30 miles, soon. The work is generally light; maximum grade 30 ft. per mile. This division of 30 miles is to be completed in three months. The officers of the company are: C. G. DYOTT, President, A. B. WILLIAMS, Secretary and Treasurer; both of 52 Wall St., New York City; W. M. COOKE, JR., Vice-President, J. E. RANKIN, Assistant Treasurer, and H. M. RAMSEUR, Superintendent and Chief Engineer, all of Asheville, N. C.

Cumberland Mt. & Tennessee.—Surveys are in progress for this road, which is projected to run from South Pittsburg, Tenn., up Battle Creek to Tracy City, and thence north along Cumberland Mountain to Lansing, Tenn., a distance of about 100 miles. The route is said to be through a rich coal region. Among the incorporators are: JESSE BROWN, of Scottsboro, Ala., S. L. MCBRIDE, of Atlanta, Ga., J. C. WALL, of Wallview, Tenn., and J. W. HUDSON, of Bridgeport, Ala.

East Tennessee Land Co.—This company has recently purchased about 15 000 acres of land from the Coal Creek Mining & Manufacturing Co., near Emory Gap, Tenn., and will, it is stated, build a railway from Harriman to Knoxville, following the route of the old Emery Gap R. R.

Mobile, Jackson & Kansas City.—At a recent meeting of the stockholders the following officers were elected: President, Col. HARTSHILL; Vice-President and General Manager, M. B. BOND; Secretary and Treasurer, R. BOWEN, and Chief Engineer, W. NICHOL. The road is projected to run from Mobile, Ala., to Brandon, Miss., 176 miles. The surveys made and it is expected that construction will begin in a short time.

Hampton & Branchville.—A company by this name has been incorporated in South Carolina to build a railway 35 miles long.

Kansas City, Chattanooga & Port Royal.—Sufficient funds are reported to have been secured to make the preliminary surveys for this road. The road is projected to run from Kansas City, Mo., to Augusta, Ga. R. A. BOWIE, of Chattanooga, Tenn., is Chief Engineer.

Guntersville, Ft. Payne & Chattanooga Valley.—Surveys will soon commence, for this road, which is projected to run from Guntersville, Ala., to Summerville, Ga.

Centerville, Maryville & Knoxville.—The East Tennessee & Georgia Construction Co. will be incorporated to build this road.

NORTHWEST.—Existing Roads.

Missouri Pacific.—A press dispatch from Sioux City, Ia., states that this company has completed arrangements for building a railway from Papillon, Neb., to Sioux City, Ia., a distance of 100 miles, and that work will begin early in the spring.

Wisconsin Central.—It is stated that this company will build the old Chicago, Lake Geneva & Pacific R. R., partly graded between Geneva and Portage City, Wis., next summer. The object is to obtain a shorter line between Chicago and St. Paul.

Wisconsin, Pittsville & Superior.—It is announced that this road will be extended from Lynn to Superior, Wis., 150 miles. The surveys have been completed and arrangements made to begin work on construction in the spring.

Louisville, Evansville & St. Louis.—Owing to unexpected delays, it is announced, that this road will not be completed between Belleville and Mount Vernon, Ill., 67 miles, by Jan. 1, as was expected. About 25 miles of track yet remain to be laid east of Belleville. It is expected that the line will be completed by Feb. 1, 1890.

Northern Pacific.—The purchase of the railway bridge across the Red River of the North, at Emerson, Man., by this company has given rise to the rumor that a line will be built to Winnipeg, Man. The route of the proposed line will be from Staples Mills north to Park Rapids and thence through the Leech Lake country to the southern boundary of Marshall County, Minn., and thence west to near the line of the St. Paul, Minneapolis & Manitoba R. R. running north to Emerson, which it will parallel to Emerson, and crossing the river at that point connect with its own line to Winnipeg at West Lynn.

Pacific Short Line.—In an interview with a reporter of the *Denver News*, J. D. NEGUS, Assistant General Manager of this company, is reported as saying that the surveys for the road had been completed from Sioux City, Ia., via O'Neil, Neb., and Fort Laramie, Wyo., along the Platte River to Fort Casper, Wyo., and thence along the Sweetwater River to South Pass. In a few weeks surveys will commence at this point and the preliminary line will be completed to Ogden, Utah. The bridge across the Missouri at Sioux City, Ia., will cost $1,350,000, and is being built jointly with the Chicago, Milwaukee & St. Paul Ry. Co. He also says:

We have completed 81 miles of construction on our line and expect to finish 135 miles more to O'Neill, Neb., by February. The entire line will be finished and ready for business in January, 1891. The first 10,000 tons of steel rails used in construction has been delivered. It will cost $19,000,000 to build the new road. The whole business is in the hands of a construction company, of which A. C. GOODWIN, of Brooklyn is President, and DONALD MCLEAN, General Manager. The Manhattan Trust Co., a solid institution of New York, is trustee of our mortgage.

The contract for building a division of 45 miles west from O'Neill, Neb., has been let to Reynolds Bros.

Sioux City & Northern.—A circular issued by General Manager F. C. HILL states that A. K. SHURTLIFF has been appointed Chief Engineer of this company. The general offices are at Sioux City, Ia.

South Sioux Falls Railroad & Rapid Transit Co.—J. C. BARTON, of Sioux Falls, South Dak., Chief Engineer, sends us the following information concerning this road

The road is now completed and in operation from Sioux Falls west 12 miles. The surveys have been carried on toward the Black Hills 150 miles further. The route is through a rolling prairie country affording very easy construction; maximum grade 30 ft. per mile and maximum curve 3°. The principal business of the road is in timber, grain, and live stock. R. T. PETTIGREW, of Sioux Falls, is President.

Ohio & Mississippi.—A press report states that work has been ordered begun on the line from Mount Vernon, Ill., to Paducah, Ky.

Projects and Surveys.

Waukesha, Pewaukee, Oconomowoc & Western.—Incorporated in Wisconsin to build a line of railway from Waukesha to Oconomowoc, Wis., a distance of 22 miles, to connect the various summer resorts of that section of the State. Among the incorporators are: A. D. CROKER, of New York City, and CHAS. L. CLASEN, HENRY J. KILLILEA, and C. P. HUNTINGTON, of Milwaukee.

SOUTHWEST.—Existing Roads.

Brinkley, Helena & Indian Bay.—This is the new charter name of the Brinkley & Helena R. R., running from Brinkley to Glenwood, Ark., 13 miles, with a branch from Glenwood to Woodsville, 5 miles. GEO. A. RICH, of Brinkley, Chief Engineer of the company, writes us that the road is to be extended 75 miles and operated to do a general freight and passenger business. About 7 miles of the extension have been completed and this portion of the road together with the old lines will be opened for traffic about Jan. 1, 1890. The road runs through a fine timber and cotton growing country, affording easy grades and curves.

Kansas City, Louisiana & Gulf.—Locating surveys are in progress on this road and construction has been commenced on a division from Arcadia, La., south 6 miles. J. H. DAWSON is Chief Engineer of the company.

New Orleans, Natchez & Ft. Scott.—A dispatch from Natchez, Miss., states, that about 2 miles of track have been laid on this road near Vidalia, La. Eighty-eight tons of 60-lb. steel rails to be used on the incline at Natchez have arrived, and another large shipment is on its way from New York.

Kansas City, Wyandotte & Northwestern.—The Kansas City & Beatrice R. R. running from Summerfield, Kan., to Virginia Station on the Chicago, Rock Island & Pacific R. R. in Nebraska, has been completed and opened for traffic.

Choctaw Coal & Ry. Co.—About 25 miles of this road east and west from McAllister, Ind. Ter., has been completed. Contracts for building 50 miles more have been awarded to Garvey Bros., and work will soon be commenced with a large force of men. The construction of this division will complete the road east from McAllister to Cavanal on the St. Louis & San Francisco R. R. It is the intention to extend the road from Canaval to Little Rock, Ark., ultimately. The extension west will run from McAllister, through the Choctaw, Chickasaw, Osage, and Pottawatomie nations to Fort Reno and Oklahoma. The road is being built in a substantial manner, all the culverts being of masonry and the bridges of iron. The track is being laid with 70 lb. steel rails and ballasted with stone. The company now has enough rails on hand to lay 100 miles of track.

Stuttgart & Arkansas River.—At a meeting of the stockholders recently held, S. M. GILLETT, of New York, was elected President, and W. S. BRADFORD, of Providence, R. I., Vice-President. The contract for building 22 miles of the road was awarded to T. H. LESLIE.

Projects and Surveys.

Kansas & Missouri Terminal.—A company by this name has been organized in Kansas City, Mo. The object of the company is to reclaim about 160 acres of land on the south bank of the Missouri River, by building a dike, and to build thereon a larger Union depot and to supply terminal facilities to the various railways now unable to obtain terminals within the city. Among the incorporators are: A. P. FONDA, and J. SPENCER, of Kansas City, Mo.

ROCKY MT. AND PACIFIC.—Existing Roads.

Seattle, Lake Shore & Eastern.—The contracts for clearing and grading the remaining 30 miles of this road north from the Skagit River have been let as follows: to Smith Bros. 15 miles from the Skagit River north, to A. W. Moore the next section of 5 miles, to Clements & Bradford from the 20th to the 25th mile, and to M. J. Heeney, the remaining 5 miles. The contract for building the 15-mile division from the Skagit River south was let to McLeod & Earle. The contracts for the bridging will probably be let to the San Francisco Bridge Co. The road is to be graded by June 1, 1890, and it is expected to have the line in operation to the International boundary by Sept. 1, 1890.

Union Pacific.—It is announced that orders have been received to build the remaining 30 miles of the Cheyenne & Northern R. R. and that work will begin at once. The surveys are completed and much of the material necessary to complete the line is on the ground.

Oregon Ry. & Navigation Co.—The contract for building the branch from La Grande to Elgin, Wash., has been awarded to Antonelle & Doe, of San Francisco.

Oregon Pacific.—Tracklaying on this road is now completed to a point 60 miles east of Albany, Ore., and a large force of men are at work on the remaining 15 miles to the summit of the Cascade Range.

Union Pacific.—A report is in circulation that this company is considering building a line of railway from some point on the Kansas Pacific R. R. direct across the country to Pueblo, Col., and thence west to the coal fields of the Wet Mountain Valley.

Projects and Surveys.

Aspen Southern.—A correspondent sends us the following concerning this enterprise:

The road is to run from Aspen, Col., south via Highlands to Ashcroft, Col., with two branches from Ashcroft, to the mines, a total distance of 36 miles. The work will be heavy; maximum grade 4 per cent, and maximum curve 16°. The principal business of the road will be in minerals from the rich iron, silver, and lead mines along the route. All of the right of way has been secured and other local aid obtained. It is expected to let the contracts for constructing the line about March 1. Tracklaying will commence about May 1, and the road be open for traffic about June 1. The officers are: President, Hon. H. A. W. TABOR, and Vice-President and General Manager, R. S. RYAN.

Newport, King's Valley & Salem.—It is announced that surveys will soon commence for this railway through the Siletz Indian Reservation in Oregon.

Denver Resort Ry. & Telegraph Co.—This company has been chartered in Colorado to build a railway and telegraph line from Denver west to Lookout Mountain, a distance of 16 miles. Among the incorporators are: H. R. FOSTER, AMOS H. ROOT, H. A. W. TABOR, and HENRY C. STUART.

Salem, Astoria & Eastern.—Chartered in Oregon to build a line of railway from Salem northwest to the coast. Among the incorporators are: E. M. WAITE, WM. ENGLAND, and H. J. MINTHORN, of Salem.

FOREIGN.

Sonora, Sinaloa & Chihuahua.—LADISLAO WEBER, of Deming, N. Mex., is Chief Engineer of this road instead of CHAS. SCOFIELD, as stated in our issue of Nov. 30.

Delagoa Bay.—This South African road is being rapidly constructed to the Transvaal border, and the section between the border and the Komate River, 2¼ miles, is under contract to be completed by Feb. 1. Tenders for the line from the Komate River to Barberton, 90 miles, have been called for, and it is expected that work will soon commence.

Guatemala.—The Guatemalan Government has entered into a contract with M. HENRI LOUIS FELIX COTTU, for a loan of $21,312,500 for the construction of a railway from Guatemala to the Port of SantaThomas, a distance otabout 200 miles.

Continental.—The Mexican Government has granted this company a concession to build a railway from Matamoras to the frontier of Guatemala, a distance of about 1,800 miles. The Government grants a subsidy of $8,000 per kilometer in 5 per cent. bonds, and gives the company all mineral lands and marble quarries along its right of way. Construction is to commence in two years.

Hidalgo.—Grading is in progress on the remaining 21 miles necessary to complete this line from Tizayuca to the city of Mexico. About 8 kilometers of the line from Tizayuca has already been completed and will be opened for traffic soon.

Mexican National.—This company has negotiated a loan of $8,000,000 for the purpose of purchasing new rolling stock and laying a third rail from Laredo to the city of Mexico. Work, it is stated, will begin at once.

RAPID TRANSIT.

Street Railways.—***Providence, R. I.***—The Union St. Ry. Co. is to be petitioned to build a line on Douglas Ave.

Brooklyn, N. Y.—The Brooklyn City R. R. Co. will build a road from the city line along 60th St. or 86th St. through New Utrecht, Bath Beach and Bensonhurst to Gravesend Bay. The line will be operated by steam motors.

Elizabeth, N. J.—The Elizabeth St. Ry. Co. will build extensions.

Philadelphia, Pa.—The Marshall St. Ry. Co. has been granted a franchise.

Baltimore, Md.—The City Passenger Ry. Co. will experiment with a compressed air motor car designed by Mr. HENRY TAYLOR. The car will have a capacity for a run of 10 miles.

Knoxville, Tenn.—The Knoxville St. Ry. Co. has completed its double track line on Gay St. The track is laid with the Wharton girder rail.

Eufaula, Ala.—A street railway is to be built by Mr. REEVES, and others. A franchise has been granted.

Fort Scott, Kan.—A syndicate from Davenport, Ia., has purchased the street railway for $100,000. The line will be extended, and electric traction may be adopted.

Pueblo, Col.—The Pueblo City Ry. Co. has bought out the old company and has applied for permission to adopt cable or electric traction.

Toronto, Ont.—The Citizens St. Ry. Co. is to be incorporated by WM. H. COMSTOCK, FRANK N. KINNER, of Toronto, R. G. HERVEY, G. J. MALLORY, and others.

Electric Railways.—***Brooklyn, N. Y.***—The Brooklyn City Railroad Co. has decided to use electric motors instead of steam motors on the line to Fort Hamilton and will extend that line to Gravesend.

Pittsburg, Pa.—The Pittsburg Traction Co. has awarded the contract for the electrical equipment of part of its lines to the Short Electric Ry. Co. —Th Pittsburg, Allegheny & Manchester Electric St. Ry. Co. has been incorporated by JOHN H. DALZELL, JOHN D. NICHOLSON, and GEO. B. HILL, of Allegheny, WM. J. MUSTIN, and A. M. KEEPER, of Pittsburg. Capital stock, $50,000.

Cincinnati, O.—The Covington & Cincinnati St. Ry. Co. will equip its Madison St. and Main St. divisions with the Short double overhead wire parallel system.

Muskegon, Mich.—The Muskegon Electric Ry. Co., will have its road in operation by Dec. 25; five motor and five trail cars will be equipped with the Short parallel system.

Scio, Ore.—An electric line is projected to run to the Oregon Pacific, R. R.

Laredo, Tex.—The electric railway was opened to traffic Dec. 8. It is operated on the Sprague system. The track is being extended.

Elevated Railways.—***St. Louis, Mo.***—Mr. A. BONZANO, Chief Engineer of the Rapid Transit Elevated Ry. Co., has been over the ground, and will start parties out very soon on the necessary surveys and levels. The company proposes to build an elevated road 7¼ miles long, and also about 20 miles of surface road.

Sioux City, Ia.—The Sioux City Rapid Transit Co. has awarded a contract to the King Iron Bridge & Mfg. Co. of Cleveland, O., for 1¼ miles of elevated railway at $243,400. The plans and specifications were prepared by Mr. GEO. S. MORISON, M. Am. Soc. C. E. The roadway will be 22 ft. high, 18 ft. wide, double track, and will be supported by steel columns 40 ft. apart. Piles 35 ft. long will be driven into the ground and 7 ft. of concrete will be placed on top of these piles as a foundation for each column. The road will extend from the present terminus of the Rapid Transit line on Leach St. to connect with the cable line. Preliminary surveys and location will be made this winter; supplies are already being put out, and the contracting company hopes to have the line ready for operation by July 1, 1890.

The Sioux City men who are behind this enterprise are E. C. PETERS, JAS. A. JACKSON, A. M. JACKSON, A. S. GARRETSON, D. T. HEDGES, ED. HAAKINSON, J. T. CHENEY, BOGGE, HEALY & TAYLOR, and A. V. LARIMER.

Cable Railway.—***Providence, R. I.***—The Cable Tramway Co. has laid its cable in the conduit and will soon have the line in operation. Mr. MIXER is the engineer.

HIGHWAYS.

Toll Roads in Indiana.—The election held Dec. 3 in Rushville, Anderson and Union townships, for the purchase of three of the toll-roads that enter the city, resulted in a majority of 593 for the purchase of the roads. The vote in Rushville township was 15 for to 1 against the purchase. The only two remaining toll-roads that enter the city will be voted free in April, leaving the county-seat free from toll-roads.

Pennsylvania.—Governor BEAVER has appointed the following members of the commission to revise and consolidate the laws relating to the construction and improvement of the roads and public highways of the commonwealth: DAVID MCCARGO, Pittsburg; JACOB BOLARD, Conneautville; CYRUS GORDON, Clearfield; H. S. GOODWIN, South Bethlehem; and SAMUEL R. DOWNING, Westchester.

Westchester County, N. J.—The Board of Supervisors of Westchester County has adopted a resolution to raise $1,000 outside the incorporated village of White Plains for the repairing and maintaining of the public highways and the additional sum of $250 for repairing and maintaining the bridges in the town outside the corporate limits.

CONTRACTING.

City Work.—***San Francisco, Cal.***—Contracts have been awarded as follows: paving with basalt blocks, Bay St. from Mason to Taylor, to J. W. McDonald, at 21 cts. per sq. ft.; the crossing of 24th St. and Bryant Ave. to T. Coyne & Co., at 26 cts.; Clarence place, to J. J. Dowling, at 26 cts.; the crossing of 24th and York St., to T. Coyne & Co., at 26 cts.; a brick sewer in Cole St. from Carl to Frederick, to E. Deady, at $1.73 per lin. ft.; a pipe sewer in Folsom St., to J. T. Jeffress, at $1.34 a lineal ft.; also in Green St., from Larkin to Polk, to John Dolan at $2 per lin. ft.

Pier Work.—The New York Dock Board has awarded the contract for the crib and bulkhead on the Harlem River from E. 138th St. to E. 140th St., to Fogg & Scribner at $59,900 for the bulkhead and $27,000 for dredging.

Cofrode & Evans, of Pottstown, Pa., have a contract for a coal pier and bulkhead at Lambert Point near Norfolk, Va., for the Norfolk & Western R. R. Co.

Canal and Dam.—Bids for the construction of a canal and dam have been received by C. J. BERGUNDTHAL, of Denver, Col., as follows: E. H. Kellogg, 12 cts. per cu. yd.; J. R. Griffin, 11¼ cts.; Foley Bros., $11,700 for estimate of 75,000 cu. yds.; Moore & Clough, $9,000; Wm. Ford, $9,375; Peters & Cains, 9½ cts. per cu. yd. D. E. Rich, $7,500 for entire work. Geo. W. Wilson, $7,500 for entire work. The contract was awarded to Geo. W. Wilson for the amount of his bid. This canal and dam are for the purpose of irrigation, storing the water in a reservoir of 1,300 acres, giving 18 ft. of water that can be drawn off of lake. The dam is 1 100 ft. long, 70 ft. wide on the bottom, 12 ft. high and 16 ft. wide on top. The canal is 5,480 ft. long, 60 ft. wide on bottom, 8 ft. deep.

Court House.—The Gage County Board of Supervisors, Beatrice, Neb., have decided to build the new court house of stone. Bids will be received for different kinds of stone.

Lumber.—At Baltimore, Md., the following proposals have been received for lumber to be used in the rebuilding of the Light St. Bridge: P. M. Womble, $20.90 per 1,000 ft. B. M.; Hess & Sandford, $20.94; J. S. Hoskins, $21.74; Heise & Bruns, $21.95; Thomas Matthews & Son, $22.25; P. Walsh & Sons, $22.50.

Removing Wreck.—The following proposals were opened Dec. 12, by Lieut.-Col. S. M. MANSFIELD, United States Engineer Office, Boston, Mass., for the removal of the wreck of a schooner in Provincetown Harbor, Mass.: Baker Wrecking Co., Boston, $1,338; J. G. Thompson, North Truro, Mass., $1,590; J. G. Whitcomb, Angus McKay and T. S. Taylor, of Provincetown, $1,400; Geo. W Townsend, Boston, $2,994.

PROPOSALS OPEN.

Machine Shop.—THE WATER BOARD, Boston, Mass. Dec. 26.

Street Work.—Granite paving, limestone, curbing, etc. THOS. G. SMITH, President, Board of Public Affairs, Cincinnati, O. Dec. 27.

Piling and Iron Work.—Round and sheet piling and lumber for foundations of Boston St. bridge. Bolts, cast and wrought-iron washers, and steel-wire spikes for the Light St. bridge. A. E. SMYRK, City Commissioner, Baltimore, Md. Dec. 27.

Dredging.—In Broad River, Del. Gen. WM. F. SMITH, U. S. Engineer Office, Wilmington, Del. Dec. 28.

Water Bonds.—Purchase of bonds for $50,000. FRANK T. DODGE, Clerk of the Water Committee, Portland, Ore. Dec. 31.

Bridges.—Plans for two wooden bridges, and their foundations, across Grand River. J. P. MAXWELL, State Engineer, Denver, Col. Dec. 31.

City Building.—Plans and specifications at the office of PROUDFOOT & BIRD, architects. W. P. MCNAIR, City Clerk, Wichita, Kan. Jan. 2.

Pier Work.—Repairing pier at foot of E. 26th St., East River; 6,042 ft. B. M. of yellow pine, 109,533 ft. of spruce, 17 oak piles, 8,927 lbs. of spikes, 18 lbs. of bolts. THE DOCK COMMISSIONERS, Pier A, North River, New York City. Jan. 3.

Canal.—About 4 miles from the Tuolumne River near Lagrange, Cal. THE BOARD OF DIRECTORS, Turlock Irrigation District, Modesto, Cal. Jan. 7.

Scow.—Col. WM. P. CRAIGHILL, U. S. Engineer Office, Richmond, Va. Jan. 7.

Artesian Well.—Diameter, 6 ins. W. H. LEVY, Clerk of Board of Trustees, Iroquois, So. Dak. Jan. 7.

Bridges.—For all county bridges to be built during 1890. Plans and specifications on file. C. W. TYRRELL, County Auditor, Waverly, Ia. Jan. 7.

Water-Works.—Specifications on file. WM. SHELTON, Mayor, Marlin, Tex. Jan. 8.

Building.—Enlargement of the American Museum of Natural History; excavation and foundations, construction and fittings. THE PARKS COMMISSIONERS, 49, 51 Chambers St., New York City. Jan. 8.

Bridge.—Wooden bridge across Mill Creek; 56 ft. span 14 ft. roadway. Bidders to furnish plans and specifications. JOHN E. PICKARD, County Clerk, Washington, Kan. Jan. 9.

Water-Works.—Plans and specifications on file. W. H. KEARY, Chairman of Water Committee, New Westminster, B. C. Jan. 15.

Road.—Through the cañon of the Grand River. J. P. MAXWELL, State Engineer, Denver, Col. Jan. 15.

MANUFACTURING AND TECHNICAL.

Market Prices.—***Rails.***—New York; $25. Pittsburg; $35 to $36 at mill, old rails, $25.35 to $24 for steel, $27.50 to $28 for iron. Chicago, $37 to $37 50; old rails, $20.50 to $22 for steel, $26.50 for iron; $20.25 for frog rails.

Track Material.—Pittsburg, spikes, $2.15 or $2.25 at Chicago, Milwaukee, St. Louis or Cincinnati; splice bars, 2.10 cts. to 2.15 cts.; track bolts, 3.10 cts. with square, and 3.20 cts. with hexagon nuts; Chicago; splice bars, 2.25 cts. for steel, $1.95 to 2 cts. for iron; spikes, 2.25 to 2.30 cts.; track bolts, 2.80 to 2.90 cts. with square, 2.95 to 3 cts. with hexagon nuts.

Old Material.—Pittsburg: No. 1 wrought scrap, at $22.50 to $23, net ton; car axles, $29, to $30; cast scrap, $16, gross ton; steel bloom and rail ends, $23.50 to $24; old car wheels, $20 to $20.50; crucible steel, $30.

Nails.—Pittsburg; cut nails, $2.35. Chicago; cut nails $2.35; wire nails, $3.

Pintsch Gas Lighting.—The New York Central Ry. has completed Pintsch gas works at Mott Haven, where the passenger cars are supplied with gas as well as the Wagner palace cars, the road having nearly 200 cars equipped. The gas is also transported to the Grand Central Depot, where it is supplied to the local cars of the New York Central, Boston & Albany, New York, Providence & Boston, and other roads entering this depot. Gas works have been completed in Chicago for supplying the Lake Shore, Big Four, Louisville, New Albany & Chicago, Cincinnati, Hamilton & Dayton, and other roads on the east side, which are now using this gas. Gas works will also be constructed at an early date at Boston to supply the Wagner palace cars, and the Boston & Albany, Old Colony, and New York & New England roads. The New Jersey Central has contracted for gas works at Communipaw, and will use the gas upon the passenger equipment. The Pullman and Wagner cars running between New York and Chicago and St. Louis are using this light, taking their supply here for the round trip. A contract has been received for lighting 1,000 cars on a railway in the Argentine Republic.

The Industrial Works, of Bay City, Mich., are completing a steam shovel to fill a recent order from the Michigan Central, making the fifth machine of this class which this company has purchased of them. They will also build one of their extension pile drivers, with car and machinery complete, on an order from the Pacific coast. Orders have been received from the Chicago, Burlington & Quincy for two 15-ton steel cranes with car; from the Cincinnati, New Orleans & Texas Pacific for two similar cranes and cars; and from the Chicago & Atlantic for a combination turn-table.

Compound Locomotive.—The Schenectady Locomotive Works, of Schenectady, N. Y., have completed a ten-wheel compound engine for the Michigan Central. The engine is built to designs patented by Mr. PITKIN, the Superintendent of the works, it has cylinders 20 and 29 ins. diameter and 24 ins. stroke, and driving wheels 68 ins. diameter.

Rolling Mill.—The Seattle Rolling Mill Co., of Seattle, Wash., has been incorporated by JAMES CARTWRIGHT, WILLIAM HAINSWORTH, L. S. J. HUNT, H. E. HOLMES, BAILEY GATZERT, JACOB FURTH, C. H. NOBLE, R. H. BOYLE, A. P. MITTEN, W. H. LLEWELLEN, S. L. CRAWFORD, C. T. CONOVER, and W. C. HILL. Capital stock, $100,000.

Cars.—The Centropolis Car & Machine Co., of Centropolis, Mo., has an order from the Armour Packing Co., of Kansas City, for 100 refrigerator cars on the Armour patent. An order for 8 passenger cars for the Kansas City & Independence Rapid Transit Ry. has also been received.

The St. Charles Car Co., of St. Charles, Mo., has turned out 4 passenger cars and 4 baggage cars for the Denver & Rio Grande. The passenger cars are fitted with the Johnson seat and with lamps for the Pintsch compressed gas.

The Ohio Falls Car Works, of Jeffersonville, Ind., have shipped two chair cars to the Kansas City, Wyandotte & Northwestern road, which are said to be the finest cars ever made at this establishment. They are equipped with buffets, smoking-rooms and lavatories, and other modern conveniences.

A car building company is to be organized at Owensboro, Ky., by ROBERT LEAMON and others.

Messrs. English, Morse & Co., of Kansas City, Mo., report that their engineering department has been very busy, having booked orders for a large number of steam plants for all classes of service. The sales include several Atlas automatic engines, also Ide high-speed engines for electric light work. A good trade is being done in belting, Hill clutch pulleys, and other specialties.

Locomotives.—The Schenectady Locomotive Works, of Schenectady, N. Y., have an order for 10 consolidation engines for the Chesapeake & Ohio; they will have cylinders 21 by 24 ins. and will weigh about 130,000 lbs. each. The works are also building 20 mogul engines for the Illinois Central.

The Baldwin Locomotive Works, of Philadelphia, Pa., have completed an engine for the Jacksonville Southeastern, and a steam motor for a street railway at Ogden, Utah.

The Brooks Locomotive Works, of Dunkirk, N. Y., are building heavy passenger and freight engines for the Big Four, the Lake Erie & Western and the Dayton, Fort Wayne & Chicago roads. Their work turned out this month will be largely for Indiana roads. They have

shipped three large engines to the Cleveland, Cincinnati, Chicago & St. Louis; these engines weigh about 82 tons, being 4 tons heavier than those built for the Lake Shore & Michigan Southern.

The Illinois Central will probably add to its equipment 20 ten-wheel engines, 6 or 7 moguls and several switc engines.

Steel Pipe.—Bids for about 22 miles of 3, 4, 6, 9, 12, 15 and 18-in. lap-welded steel water-pipes, and specials, for water-works at Pretoria, So. Africa. Pritchard & Co., Engineers, 2 Storey's Gate, Westminster, London, England. Dec. 31.

The Dunham Manufacturing Co., of Boston, reports a very active trade in its varied lines, the Dunham storm-proof car-door claiming a large share of attention at this season of the year, owing to the improvements now being added to the well-known and widely used freight, fruit, stock and baggage car-doors, and a large number of orders are being placed for equipment for new cars now under construction and to be built the early part of the coming year. Sales of the Globe ventilator are steadily increasing as the value of this device becomes recognized. The Pullman Palace Car Co. has recently placed orders for a large number, also the C. B. & Q. and the Missouri Pacific.

Rock Breaker.—The Farrell Foundry & Machine Co., Ansonia, Conn., manufacturers of superior rock and ore breakers, has sold one of the latest improved machines to the city of Sault Ste. Marie, Mich. It has a capacity for crushing from 80 to 100 tons of stone a day, and is now working at the latter speed crushing boulders for street paving purposes.

The Roanoke Engine & Machine Co. has been organized at Roanoke, Va. President, LEE H. SIMMONS; Vice-President, WM. LUMSFORD; Secretary, L. T. POWELL. Capital stock, $1,000,000.

Storage Batteries.—The Storage Battery Motor Co. has been organized at Chicago by F. E. HINCKLEY, F. G. HOLTON, and H. F. WEST. Capital stock, $2,000,000.

Pump.—The Buffalo Steam Pump Co. is building a compound duplex pump of 2,000,000 gails. daily capacity for the Buffalo board of trade.

The Pond Engineering Co. will furnish and erect a 200 H. P. compound condensing Armington & Sims engine at the new Omaha Thomson-Houston Co.'s station in Omaha, Neb. Rope transmission will be used. The company will furnish the Missouri Pacific Ry. with a vertical submerged flue boiler, the Shotwell Mining Co. with a large Blake mining pump, and the Gay Building, St. Louis, Mo., with a 100 H. P. heater. It has also the contract for a complete 80 H. P. plant in Murphysboro, Ill.

Sewer Pipe.—The Anderson Indestructible Sewer Pipe Co. has been incorporated at San Francisco, Cal., by HENRY ANDERSON, F. V. MCDONALD, and D. S. DORN. Capital stock, $1,000,000.——The Grand Ledge Sewer Pipe Co. has been organized at Grand Ledge, Mich. President, S. B. GRANGER; Secretary, F. A. TABER; Superintendent, W. R. QUANTRILL. Capital stock, $10,000.

Rai way and other Material Wanted.—About 100,000 cross ties for the Knoxville extension. E. J. PIERCE, Superintendent of Construction, Marietta & North Georgia Ry., Marietta, Ga.

Light locomotive and 1¼ miles of 16 or 20-lb. rails. G. C. Gibson & Son, Magnolia, Miss.

Rails, 2 miles, 6 logging cars. A. W. Morris, Bowers, Tex.

Logging locomotive, 36-gauge. Flowers & Peagler, Forest, Ala.

Rolling stock, John A. Devlin, Due West, S. C. Disintegrator wanted for grinding caked sulphrite potash. W. W. Parce, De Land, Fla.

Corrugated iron roofing and siding. The Montgomery Terminal & St. Ry. Co., Montgomery Ala.

Street sweeper. The City Clerk, Harrisburg, Pa.

Light second-hand T rails; 10 to 15 tons. R. D. Gribble & Co., 5th Ward, Houston, Tex.

BRIDGES AND CANALS.

Bridge Notes.—***Alburgh, Vt.***—Mr. P. L. BERMAN, County Surveyor of Grand Isle County, states that the Grand Isle bridge project has fallen through for want of funds. Nothing will be done until the Legislature meets and makes another appropriation.

Montgomery, Pa.—The new iron bridge for the Philadelphia & Erie road has been completed.

Woodwardville, Md.—The Baltimore & Potomac R. R. Co. and Anne Arundel county will build an iron bridge across the Patuxent River.

Knoxville, Tenn.—A bridge is to be built across W. 5th Ave. The Knoxville & Ohio Ry. Co. has subscribed $5,000 toward the cost.——The Knoxville Southern Ry. Co. is ready to receive bids for the construction of the substructure and superstructure of its bridge over the Tennessee River. Major J. W. WILSON is the engineer in charge.

Hadley, Ky.—Proposals for an iron bridge across Gasper creek will be received by J. C. SIMS, of Bowling Green.

Centreville, Ala.—Another bridge is to be built across the Echeconnee River by Phillips & Amerson.

St. Augustine, Fla.—Work will be commenced at once on the iron bridge across the North River for the St. Augustine & North Beach Ry.

Vernon, Ind.—The County Auditor, J. C. COPE, has awarded the contracts for two iron bridges to the Massillon Bridge Co., of Massillon, O., for $5,839. The contract for masonry has been let to Dixon & Broiley, of North Vernon.

Bay City Mich.—The Board of Supervisors held a meeting Dec. 9, for the purpose of taking action toward the building of a new bridge across Saginaw River at the foot of Belinda St, in the first ward. A committee was appointed to draft a resolution for holding a special election on Jan. 20, when will be submitted to the people of Bay County a proposition for the raising of $45,000 by bonds for bridge purposes.

Omaha, Neb.—Bonds for $250,000 have been voted towards the cost of the construction of a railway bridge across the Missouri.

Little Rock, Ark.—A bridge is to be built across Worthens bayou. Particulars may be obtained from Mr. MARTIN, Bridge Commissioner.

Lander, Wyo.—A contract has been let to a Leavenworth firm for the construction of an iron bridge across the Wind River near Lander. The work will be paid for by the Government, which has already appropriated $25,000.

Houston, Tex.—City Engineer LEWIS has been preparing plans and estimates for two bridges.

Bastrop, Tex.—The following proposals for the construction of a bridge across the Colorado River have been received by R. L. BATTS, Secretary of the Bastrop Bridge Co.: Milwaukee Bridge & Iron Works, Milwaukee, Wis.; $50,000 for first plan, $44,200 for second plan. Berlin Iron Bridge Co., East Berlin, Conn., $58,250, $55,000. Missouri Valley Bridge & Iron Works, Leavenworth, Kan., $54,000, $48,865. Pennsylvania Bridge Co., Beaver Falls, Pa., $48,000, $45,295. Geo. E. King Bridge Co., Des Moines, Ia., $47,500, $43,250. King Iron Bridge & Mfg. Co., Cleveland, O., $50,165, $50,165. Chicago Bridge & Iron Co., Chicago, Ill., $45,000, $42,000. The first plan was adopted and the contract was awarded to the Chicago Bridge & Iron Co. for $45,000. The bridge will consist of one cantilever span of 322½ ft., and two short spans of 150 ft. each, with about 650 ft. of wooden approaches.

Sioux City, Ia.—The Phoenix Bridge Co., of Philadelphia, Pa., has the contract for the railway highway bridge over the Missouri for the Pacific Short Line. There will be two draws and the cost will be about $1,120,000.

Canals.—***Okefenokee.***—The Okefenokee Land & Drainage Co., of Waycross, Ga., is about to commence the drainage of the Okefenokee swamp. It is intended to cut a canal through the swamp. The company has a capital stock of $4,000,000. Dr. A. H. W. MARQUIS, of Waresborough, Ga., is president.

Canals.—***Dismal Swamp.***—The name of this Virginia Canal has been changed to Norfolk and North Carolina Canal.

Port Townsend, Wash.—An engineering party is making a preliminary survey across the portage which separates Port Townsend Bay from Oak Bay, with the intention of cutting through a canal large enough to admit the passage of the largest ships and steamers. This canal will be of great benefit to the commerce of the Sound, and will greately enhance the value of property.

Trent Valley.—The Trent Valley Canal Commission has held a meeting and taken evidence at Peterboro, Ont, and will visit Barrie, Orillia and Lindsay, in January. The general impression seems to be that the canal is a feasible project.

Tay.—Mr. Davis, contractor for the enlargment of the Tay Canal (Canada), has left Perth, all work having been finished for the year. The dredge *Rideau*, which he had constructed at Welland, has been sold by the contractor to the Government for Rideau Canal work, for which it is specially suited. The price is understood to be $6,000. It is said that the work on the canal came to an end abruptly, and a suit between the Government and Messrs. Davis may ensue, disputes having arisen between the engineer, Mr. WISE, and the firm. The department holds that the work is not yet completed, a claim which the contractors deny.

ELECTRICAL.

Electric Lighting.—***Northfield, Vt.***—A village meeting was held recently to consider the question of electric lighting. Wires may be run from the plant at Montpelier. The Thomson-Houston Co. has made a proposition.

Syracuse, N. Y.—The city will contract with the Syracuse Electric Light & Power Co. for 130 more electric lights for 3 years from Feb. 1, 1890, at 38½ cts.

Dansville, N. Y.—The Dansville Electric Light & Power Co. will probably enlarge and extend its plant, as the lamps are being extensively adopted as a substitute for gas.

Jamestown, N. Y.—A special vote will be taken Dec. 28, on the proposition for the city to put in and operate an electric light plant of its own. The amount to be raised, should the citizens decide in favor of the city purchasing its own plant, would be $25,000. The people voted before this year on the question, and decided against the bonding scheme, but the vote was light, and it is claimed was not representative.

Bloomfield, N. J.—The unsettled contract for lighting the streets of Bloomfield with electric lights, which has been pending for some time between the Edison Co. and the Bloomfield Township Committee, was the subject of discussion at a special meeting of the committee on Saturday night. The taxpayers are thoroughly aroused in regard to this proposed contract, and they are desirous that all the powers conferred under it shall be enunciated in unequivocal terms, in order to avoid possible litigation. They requested that the committee publish the contract before signing it, and submit it to a public meeting of the citizens for discussion. The request will be acceded to.

Irvington, N. J.—The Village Trustees have decided to substitute incandescent lights for the gas that now illuminates the streets. This new light, which is to be furnished by the Newark Electric Light & Power Co., will cost $700 a year more than the gas, but the lights will be burned until daylight, while now the lights are put out at 2 o'clock.

Reading, Pa.—The Councils' Special Committee on Electric Lighting has resolved to recommend to Councils that the city erect its own electric light plant, and an ordinance looking to this end has been prepared. The estimated cost of a plant suitable for the present needs of the city is $100,000. The lighting of the city at present costs $87,000 per annum. The committee estimated that for $17,000 a year the city can get as much light and at the same time place enough in the sinking fund to pay off the debt incurred in twenty years.

Berkley, Md.—The Edison Electric Illuminating Co. has been organized. President, M. W. MARTIN; Secretary, S. W. WALKER; Treasurer, GEO. M. BOWERS.

Blacksburg, S. C.—The Blacksburg Electric Light Co. has been organized by J. F. JONES, W. W. HARDIN, and F. P. BEARD.

Tallapoosa, Ga.—The Vernon Electric Light & Power Co. has been organized by G. F. QUACKENBUSH, H. W. BERNARD, J. A. BURNS, and others. Capital stock, $25,000. The contract for plant has been let to the Edison Co.

Ocala, Fla.—An electric light company is to be organized by GEO. BROWN and others.

Lake Charles, La.—A company has been organized, with a capital stock of $25,000 to put in electric lights and water-works. G. W. RANDALL, of Brownsville, Tex. is interested.

Taylorville, Ill.—The Taylorville Electric Light Co. has been organized. President, W. W. ANDERSON; Secretary, J. N. C. SHUMWAY; Treasurer, F. W. ANDERSON. Capital stock, $15,000.

St. Louis, Mo.—As the contractor for electric lighting will not have the plant in operation by Jan. 1, according to his contract, an ordinance has been introduced for lighting the streets with gas until the contractor, Charles Sutter, is ready to carry out his contract.

Van Buren, Ark.—R. H. BROWNE has applied for an electric light franchise. A Thomson-Houston plant will probably be used.

Salida, Cal.—The City Council has decided to abandon the present system of street lights and replace the incandescent lamps with arc lights of 3,000 c. p. Work on stretching the wires has been commenced.

Harriston, Ont.—The Council has contracted with the Reliance Electric Light Co. for the lighting of their town at the rate of 20 cts. per light of 2,000 c. p. per night.

SEWERAGE AND MUNICIPAL.

Victoria, B. C.—The by-law sanctioning a loan of $650,000 for the construction of a sewerage system, according to plans prepared by PICKERING and COMPTON, of England, was defeated two to one by a vote of the real estate owners about two week ago. This does not indicate that the citizens are opposed to a proper sewerage system, or are ignorant of the advantage of such a system. The defeat of the by-law is reported to have been due mainly to the fact that the sum asked for was generally considered inadequate for the construction of the system proposed, as the engineers, in their report, estimated rock excavation at about half the price it is known that it would cost. A large portion of the excavation will be in the hardest kind of trap-rock, and the engineers' estimates being in error to such an extent in this important item, the confidence of the people in the whole project was shaken. It was thought by many that it would take about $1,000,000 to build the works as proposed, a sum out of proportion to what a complete system for a city of this size should cost.

East Liverpool, O.—The Board of Sewer Commissioners, after making the final settlement with the contractor, presented to Council their report, together with that of their engineer, Mr. JOHN G. UNKEFER, giving details with regard to the location, construction, and conditions of the sewers. The system was constructed on the Waring plan, and consists of 3,305 ft. of 10-in. pipe, 8,368 ft. of 8-in. pipe, and 31,942 ft. of 6-in. pipe, together with 11,824 ft. of 4-in. house connections, manholes, flush-tanks, inspection pots, etc. Work was commenced May 15, 1888, and the contract completed April 1, 1889, since

which time the system has been in use and is giving good satisfaction. The Commissioners in their report spoke very highly of the skill and ability of Mr. UNKEFER, their engineer.

Sewers.—*Tonawanda, N. Y.* — Bids on 14 miles of brick and pipe sewers were opened Dec. 18. The plans were prepared by WM. B. LANDRETH, C. E., of White Plains, N. Y., and the work will be carried out under Mr. LANDRETH and Mr. B. F. BATTS, City Engineer.

Lexington, Ky.—The Legislature will be petitioned to authorize the city to issue bonds for the construction of a sewerage system.

Savannah, Ga.—Mr. RUDOLPH HERING has prepared plans for the construction of the sewerage system previously reported. For particulars address the Mayor.

Jacksonville, Fla.—The question of bonding the city to the amount of $750,000 has been submitted to popular vote, and defeated by a majority of 410. This money was to have been used in extending and improving the present sewer system, in reclaiming lowlands, in bulkheading the water front, and in general public improvements.

Kansas City, Mo.—The City Engineer has completed the plans for the district of O. K. creek sewer. The contract will probably be let in three sections, so that the work may be carried on rapidly.

Street Work.—*Baltimore, Md.*—None of the improvements to be made under the $5,000,000 loan are deemed to be of greater importance than the widening and straightening of the narrows of East Baltimore St., and the widening of Fayette St., westward from Calvert St. These improvements are to solve in part the question of intercommunication between two sections of Baltimore where travel is hindered by a natural line of steep hills running from north to south just west of the line of Calvert St., and extending almost from the basin to North Ave.

Wichita, Kan.—Proposals for paving will soon be advertised for. Seven streets will soon be ready. H. H. JACKMAN is City Engineer.

Montreal, Que.—About $500,000 will be spent next year in block or asphalt paving.

WATER-WORKS.

NEW ENGLAND.

Malden, Mass.—An order has been passed by the City Council authorizing the mayor to petition the next Legislature for the right to issue $600,000, of additional water bonds; $500,000 to be issued in January, 1890.

MIDDLE.

Tonawanda, N. Y.—The Tonawanda City Water Works Co. has issued $120,000 of second-mortgage water-loan bonds, secured by a second-mortgage for a like amount, given to the American Loan & Trust Co., of New York. The bonds are issued to secure money for improvements, extensions, additions, etc.

Baldwinsville, N. Y.—The main across Seneca River has been completed.

Springville, N. Y.—The Springville Water-Works Co., has filed a mortgage for $20,000 with the American Loan & Trust Co., of New York, and will issue bonds for that amount.

Amsterdam, N. Y.—The contract to furnish the vitrified pipe for the Hans Creek conduit line has been awarded to J. V. Morris at $31,753.71. For furnishing the cast-iron pipe and specials to the Warren Foundry & Machine Co., at $14,208.51.

Sag Harbor, N. Y.—A satisfactory test of the new works has been made. Engineer and contractor, Charles Moore.

Summit, N. J.—The Commonwealth Water Co. will soon put their new works into operation. Water is pumped from a well, 15 ft. in diameter by 30 ft. deep, to a stand-pipe, 150 ft. high.

Camden, N. J.—The Chairman of the Water Committee of the City Council has been authorized to appoint a committee of five to formulate a plan for a pure water supply.——A syndicate, represented by E. N. COHN, has made a proposition to purchase the works and meet all outstanding obligations, for a sum not exceeding $500,000, with a proviso that bonds be given not to exceed the present rate of water tax.

Bel Air, Md.—It is reported that steps are being taken to secure works. Also that O. S. LEE can be addressed for information.

Allegheny, Pa.—The extension of mains into suburban parts of the city will be commenced in the spring. About 20 miles of new mains have been laid, and 225 additional hydrants sets during the past season.

Monongahela City, Pa.—The new works have been satisfactorily tested. Water is pumped from a large well by a Holly-Gaskill pump to a distributing reservoir. Contractors, Wilson & Smith, of Saltsburgh, Pa.

Saltsburgh, Pa.—We have received the following information from ROBT. H. WILSON:

> Plans for a complete system of works have been prepared by Wilson & Smith. Work will probably not be commenced until next year. The plans call for 3½ miles of mains a 750,000-gall. reservoir, and pumping machinery with a daily capacity of 500,000 galls. The plans have been favorably received by the committee in charge, and an election to decide the question will soon be held.

SOUTHERN.

Alexandria, La.—Mayor THOMAS CRAWLEY is reported as stating that they propose soon to take steps to secure specifications for, and have established, a complete system of works.

Lake Charles, La.—For information regarding another project for works, address G. W. RANDALL, of Brownsville, Tex.

Glasgow, Ky.—It is reported that the company will add a new pump and stand-pipe in the spring.

Troy, Ala.—A 20 years' franchise for building a system of water-works has been granted to E. WOLTMANN, 11 Wall St., New York. The city will pay $50 each for 60 hydrants. There will be about 5 miles of mains. The supply will be taken from wells, and pumped to a stand-pipe, 15 ft. in diameter by 90 ft. high.

NORTH CENTRAL.

Bellefontaine, O.—The new pumps have been put in operation. They have a maximum capacity of 86,400 galls. per hour. Water is pumped from two artesian wells.

Logansport, Ind.—The following bids for furnishing additional pumping machinery of 2,000,000 galls. capacity were received on Dec. 6, by WALTER A. OSMER, City Engineer:

Geo. F. Blake Mfg. Co., of Boston, Mass., pumps, $4,600; Geo. C. Morgan, of Chicago, Ill., pumps and pipe laying complete, $11,236; Deane Steam Pump Co., of Holyoke, Mass., pumps, connecting pipe, and valves, complete, $6,430; gearing to water wheel, $5,200; Gordon Steam Pump Co., of Hamilton, O., pumps complete, $3,351; Holly Mfg. Co., of Lockport, N. Y., pumps erected and connected with conduit pipe, complete, $6,824; Stevens & Bedwards, pipe and pipe laying, complete, $9,013.76.

NORTHWESTERN.

Minneapolis, Minn. — The Council Committee on water-works has rejected the seven bids received for furnishing approximately 3,018 tons of cast-iron pipe.

Brookings, Dak.—Construction has been commenced. Water will be pumped by the electric light company's engine from an artesian well to a tank 36 ft. high.

Helena, Mont.—E. Sutphin, of St. Louis, Mo., has offered to make a detailed survey and submit a proposition for supplying the city with water from the Missouri River.

Minden, Neb.—The following information is from J. P. PUGH, City Clerk:

> The town will issue $25,000 of bonds for constructing works. No date for letting contracts has been decided upon. Water will be pumped from wells to a stand-pipe. Population, 1,700.

SOUTHWESTERN.

Kansas City, Mo.—An ordinance has been introduced in the City Council to notify the company that the city declines to purchase its plant or renew its franchise. It is also reported that correspondence has been begun with contractors whom the city proposes to engage to build their works.

Van Buren, Ark.—The question of establishing works is being discussed.

Mallis, Tex.—Bids for constructing works will be received until Jan. 8, 1890, by WILLIAM SHELTON, Mayor.

San Diego, Tex.—Dr. L. B. WRIGHT, Secretary, informs us that a small system of works is to be constructed by a company. Water will be pumped from Daimer Creek to a reservoir. Estimated cost, $2,500. Population, 1,500.

Holyoke Col.—The new works have been satisfactorily tested. Water is pumped to a stand-pipe of 125,000 galls. capacity. There are 6 miles of mains. The works were built by the Lincoln Land Company.

Lake City, Col.—It is expected that work will soon be commenced on the construction of the new works. The contract price is $19,000. The water is taken from a reservoir, formed by a dam, 1½ miles above the town on the lake fork of the Gunnison River, which will give a fall of about 107 ft.

Denver, Col.—The capitol stock of the Lookout Water Supply Co. is reported as $100,000, instead of $10,000. The officers are: BIDDLE REEVES, President; CHARLES WELCH, Vice-President: A. W. WOODBURY, Treasurer; F. G. PATTERSON, Secretary.——The Citizens Water Co. will soon commence work on a 9,000,000-gall. storage reservoir. It will cover an area of 400 acres, and be 200 ft. Its location is 10 miles from the Platte Cañon, and 20 miles from the city. Several smaller reservoirs will also be constructed.

Lake City, Col.—A. M. WILSON, City Clerk, sends us the following:

> S. F. Wicks, of Colorado Springs, Col., was awarded the contract for building works on Dec. 15. They are to be completed by March 1, 1890. The contract calls for about 3 miles of pipe and 17 hydrants. Water will be conveyed by gravity from the lake fork of the Gunnison River. Estimated cost, $19,000. Bonds for $25,000 have been issued. Population, 1,500.

PACIFIC.

Seattle, Wash.—Preliminary surveys for the new works are nearly completed.

Cheney, Wash.—The Cheney Water & Land Co. has been incorporated at Olympia. Capital stock, $100,000. The Trustees are G. H. LEONARD, W. H. DUNKIN and OSCAR HUBER.

La Conner, Wash.—Works have been completed. The officers of the La Conner Water-Works Co. are: President, G. V. CALHOUN; Secretary, L. L. ANDREWS Manager, J. S. CHURCH.

Roseburg, Ore.—The new works have been successfully tested. There are two reservoirs with a capacity of 300,000 galls., respectively.

Dixon, Cal.—The new works are to be erected by A. A. Osborn, of Benicia. They will consist of a pumping plant, large wooden tanks as reservoirs, 8-in. mains, etc. The city pays $50 per month for 12 hydrants.

Santa Cruz, Cal.—The Risdon Iron Works have been awarded the contract to erect the new works. The contract for constructing the dam and reservoir has been sublet to Kelso & Dare.

Mayfield and Menlo Park, Cal.—The Manzanita Water Co. has begun suit in San Mateo County to condemn the water rights of planters on San Francisco Creek. It is their intention to construct a large reservoir and furnish water to these towns and the surrounding country.

Los Angeles, Cal.—WILLIAM MULHOLLAND, Superintendent, has sent us the following:

> The company will soon add a 2,000,000-gall. pumping plant to supply a small elevated territory where the gravity pressure is insufficient.

Marysville, Cal.—The old pumping machinery will soon be replaced by a larger and better plant.

CANADA.

St. Thomas, Ont.—The Water Committee has decided to procure water for domestic purposes by filtering Kettle Creek water. A dam will be constructed, impounding 10,000,000 galls., and four filters will be used to purify the water. Three steel boilers and two Worthington pumps each of 2,000,000-galls. capacity will be put in the pumping house. It is estimated that the city will consume from 700,000 to 1,000,000 galls. per day, and that the proposed works will cost $150,000.

ARTESIAN WELLS.

Deloraine, Manitoba.—Work is to be resumed on the well and continued until water is secured.

Monticello, Ark.—A well is to be sunk by E. BOREHARDT.

Pasco, Ore.—A well has been sunk 600 ft.

IRRIGATION.

Ogden, Utah.—The directors of the Bear Valley Canal Co. have elected the following permanent officers: Professor ELWOOD MEAD, of Wyoming, General Manager; F. E. ROACH, Manager of Water Rights and Land Department; C. C. RICHARDS, General Solicitor; CHARLES H. NICOLET, Auditor. Mr. JAMES D. SCHUYLER is the Consulting Engineer.

Colorado.—The Arkansas River is to furnish the source of another large irrigating canal. The headgate will be from 3 to 5 miles west of La Junta.

El Paso, Tex.—The Rosenfeld Construction Co. has closed a contract with a party of English capitalists to construct an irrigating ditch from Las Cruces, N. M., 30 miles east, to bring under cultivation 60,000 acres of land. The contract price is $140,000.

Modesto, Cal.—The Board of Directors of the Turlock Irrigation District has advertised for bids for 4 miles of work upon the head of the canal, embracing the heaviest work on the route. The canal leaves the Tuolumne River a mile above La Grange. Bids will be opened at Turlock, on Jan. 7, after which work will be prosecuted until finished.

Denver, Col.—Articles of incorporation of the Sisson Irrigating Ditch Co. have been filed by JOHN SISSON, BENJAMIN F. ACUFF and JAMES A. SISSON, of Prowers County. The capital stock is placed at $3,000.

Pueblo, Col.—The Arkansas River Water Power Co. has been incorporated at Denver. Capital stock, $50,000. The incorporators are: NIMROD S. WALPOLE, JOHN NORRIS, JOHN C. STRIBLE and ROBERT GRANT, of Pueblo. The object of the company is to build and construct ditches and canals in Pueblo, Fremont, El Paso, Chaffee and Las Animas counties. The principal office will be in Pueblo.——Articles of incorporation of the Rocky Ford Ditch Land, Loan & Improvement Co. have been filed with the County Clerk. The objects of the company are to construct, maintain and operate canals, reservoirs and laterals for irrigation, etc.; to appropriate water from the Arkansas river; to possess, lease and cultivate lands, etc. The capital stock is $200,000, divided into 2,000 shares. The directors are GEORGE W. SWINK, B. U. DYE, WILLIAM A. COLT, WILLIAM C. BURKE and GILBERT M. HALE.

The first canal to be constructed by the company is to begin on the south bank of the Arkansas river and to run in a southeasterly direction. It is to be 40 ft. wide on the bottom and have a capacity to irrigate 56,000 acres.